THE

ELECTRICAL REVIEW.

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ELMORE PERPETUAL ISSUES.

THE French Elmore Company is again in the market—not with copper commodities, but with shares. This time it is "20,500 Perpetual Ten per Cent. Preference Shares of £2 each," which the public is invited to absorb. We have looked through the prospectus in the endeavour to discover what the "perpetual" refers to, but have been unsuccessful. It does not refer to the 10 per cent.—unless it is earned. The 10 per cent. is guaranteed for one year only by the Foreign and Colonial Elmore Company, who are thus disposing of a portion of the large sum they received from the French Company for the patent rights of the process, and who previously provided capital on the security of debentures. The "existing debentures" are to be paid off by the issue of 26,250 preference shares; 13,250 shares have already been issued, and these, with the 20,500 now offered, complete the 60,000 preference shares authorised at the general meeting. Starting with a large capital, the company has therefore since added £120,000 to it. Interest at 10 per cent. will have to be paid on this amount before the original shareholders can receive anything. However, original shareholders have already invested. We have to consider now what inducements are offered to investors for the present issue? Nothing whatever new. Mons. Secretan's ridiculous estimate, apportioning phantom profits of 15 per cent. on preference shares, 20 per cent. on ordinary shares, and leaving besides a surplus of £44,240, is old. The prospectus, in fact, contains the usual Elmore information. Orders "have been coming in from the most important industrial establishments in France;" but how many orders and how much profit is being, or has been, made on them? Information on such points would be useful to an investor, but he will not find it.

With the prospectus are issued two other documents—copy of report of Sir Frederick Bramwell, F.R.S., and H. Graham Harris, M.Inst.C.E., and extract from *Truth* newspaper of June 16th last.

In the absence of commercial information scientific reports have been useful to the Elmore Companies before. We should be extremely sorry if the reports of engineers and other scientific experts were to cease to inspire the public with confidence. It will be the fault of the experts themselves if they do. In these days it will be necessary for them to exercise great care, not only that their reports are accurate, but to consider the purpose for which the reports will be used. If they are required for circulation with a company prospectus, and are obtained for the purpose of influencing the subscription of capital, more than usual care should be exercised by the writers, and that in proportion to their eminence in their professions, and the estimation in which they are held by the public.

Mr. Harris visited the Dives works, and his firm made a detailed report on the 8th inst., they were informed that,

for trade reasons, the company did not desire to publish it, but wished to have some brief expression of the opinions they had formed during their investigations into the process. They therefore report afresh on July 16th, and give their opinions with brevity on questions within their province, and more fully on questions out of their province. Certain rough workshop tests were made, which proved that the material was one having exceptional ductility and homogeneity, being much superior to the ordinary copper tubes to be obtained in the market. These workshop tests are confirmed by other tests previously made by other people. Samples were taken, will be tested, and the results reported on, but they believe they will prove to be equally satisfactory. It was found that mistakes had been made in the manufacture in the past. As careful investigation as possible was made into these matters, having regard to the time at disposal, with the result that they feel justified in saying that they have been overcome. The probable demand for articles manufactured by the process is, in their judgment, a question more for experts in the copper trade than for engineers, but a careful examination of the books to ascertain as far as possible the number and rate of increase of orders, apparently did not appear to them to be more a question for auditors or commercial men than for engineers, and consequently we are told that there has been a fair increase, and many customers have repeated their orders, enabling the reporters to form the opinion that a steady demand may be anticipated. Estimates were furnished by the managing director showing the cost of manufacturing the articles with specified outputs, excluding some things and including some other things. The engineers checked the figures as far as they possibly could by the information they obtained from the books, and are of opinion that one estimate is too sanguine, another will be realised, and the third may certainly be accepted. As regards the works they appeared to be well designed and constructed. Nothing has been done which can be characterised as in any way either wasteful or extravagant, except that some of the buildings are rather ornamental considering the position in which they are placed. We have reserved for final remark the statement that the works at Leeds have not been in operation producing a marketable commodity for a longer period than some six or seven months, while the works, at Dives have been in operation only from the commencement of May last, and we should like these statements to be compared with the statements made in directors' reports, at shareholders meetings and otherwise, as recorded in our columns.

The detailed report of Sir Frederick Bramwell, F.R.S., and H. Graham Harris, M.Inst.C.E., which, for trade reasons, was not published, may be the valuable report which should be expected from so eminent a firm, but, unfortunately, it is not before us. We have, however, no hesitation in saying that the report which, for trade or other reasons, is published, is not such as we should have expected from them. If they were to go beyond the region of dry facts at all, they might have told us not merely whether a few hundred pounds had been unnecessarily spent on the buildings in concession to French taste for ornamentation, but whether the hundreds of thousands of pounds embarked in the undertaking as a whole was an expenditure which could be considered discreet.

The report contains certainly no definite information to enable an opinion to be formed, and no definite opinion is expressed, as to the value of the Elmore process as an investment with the capital embarked in it, but it is so far favourable in its generalities as to enable the directors to refer to it in the prospectus as giving "still further evidence of the great future of the process from actual results, and to say that what has been advanced in former reports of experts or directors with regard to the process, has been completely confirmed by the eminent firm in question. The extent to which the report has been made to serve the purpose of obtaining subscriptions, and the responsibility consequently attaching to the writers of the report, may be gathered from the following paragraph in the prospectus:—

"The directors feel certain that the subscribers will fully appreciate the report coming from experts of the world-wide reputation possessed by Sir Frederick Bramwell and Mr. Harris, and it is particularly gratifying to receive such confirmation of the views of the directors as to quality, prospects of business, and cost of manufacture." In justice to the experts of world-wide reputation, it is desirable to recall the purport of their report on the three points mentioned. Quality:—Rough workshop test showed ductility and homogeneity. Prospects of business:—A qualified statement that a steady demand may be anticipated after reference to the fact that the question is one for experts in the copper trade rather than for themselves. Cost of manufacture:—Limited to checking estimates submitted by manager on hypothetical outputs.

The article from *Truth* describes a visit paid by their representative to the works at Dives. The representative states that he is not an engineer, but was accompanied by an electrical engineer (was it Mr. Harris?). We need waste no time in criticising *Truth's* article, but we may say that whilst the engineer's report contains much that would have been more appropriate in *Truth*, the article contains something that would have been more appropriate in the report. "All the smaller tubes are now drawn down from the standard sizes, after being taken from the tanks, this being a very important addition to the process for manufacturing the smaller size tubes." We thought we had followed the Elmore process through its various ramifications, and we certainly have the impression that one of the greatest advantages claimed for it consisted in the absence of any mechanical work, such as drawing, &c. Now we are told that the drawing down of a large tube to a small one is an important improvement, and we may reasonably wonder how long it will be before it is discovered that an important improvement may yet be found in the manufacture of the large ones.

The present issue of capital is exceptional, in that the subscription lists do not close before the issue of the technical journals. We may, therefore, with some hope of slightly influencing investors, call their earnest attention to the previous history of the Elmore Companies; the enormous capital already invested in the process, and the total absence of any information indicating the profitable employment of that now offered. Subscribers will receive during the first year £10 for every £100 they invest. That is all that can be said with certainty. For the rest, they must exercise their judgment, and weigh very carefully the information that is put before them.

THE CHICAGO EXHIBITION.

THE Electrical Trade Section of the London Chamber of Commerce has issued a circular to the members inviting their co-operation with a view to promoting the success of the English Electrical Section at the Chicago Exhibition on the lines suggested by Mr. Preece, which we reported last week. The thanks of English electricians are due to Mr. Preece for his efforts in this direction, and it is certainly to be hoped that they may meet with success.

It is inevitable that exhibitors should look for some material results from exhibitions, but we believe the looking for immediate results is a mistake which is too often made. The McKinley tariff is certainly responsible for some of the disinclination to exhibit at Chicago, but possible exhibitors should remember that the McKinley tariff is not necessarily a permanent institution. The tariff question is an important feature of the present Presidential campaign, and the large number of enlightened Americans who have always protested against the evils of protection are by recent events likely to have some object lessons to help them in their efforts at tariff reform.

If there is to be an English Electrical Section at all, it should certainly be worthy of us. Without remarking on any individual exhibitors in the list we published last week, we are obliged to say that it is neither adequate nor representative. If English electrical firms were to carefully consider the question—to study the nature of American imports—we think it should be possible to make a better and more complete list. Mr. Preece's suggestion was, we believe, quite in accordance with the fitness of things. McKinley tariff, or no McKinley tariff, America will import articles of luxury and beauty. It is not the home of hand-made metal work, though much finds its way there. It is not the home of scientific instruments requiring delicate handiwork, though it ought to require their use in increased numbers. There are but two instances of possibly desirable exhibits. There must be plenty of others. If exhibitors would avoid sending coals to Newcastle, we see no reason why an exhibit should not be profitable. It behoves us all to support Mr. Preece in his laudable efforts to obtain a good and representative exhibit. Rather no English section at all than a poor one.

The Theory of the Transformer.

AS ordinarily treated the coefficient of self and mutual induction of transformers is assumed to be a constant, and many false conclusions are thus drawn from it. Hence, Mr. Henry A. Rowland has recently proposed to treat the theory in general, taking account of the hysteresis as well as the variation in the magnetic permeability of the iron. A paper has appeared in the *Johns Hopkins University Circular* by Mr. Rowland on this subject, and there is a reprint of it in the July number of *The Philosophical Magazine*. The problem is mathematically treated by the method of magnetic circuit first applied by Mr. Rowland to iron bars in a paper on "Magnetic Distribution" (*Phil. Mag.*, 1875, L. pp. 257—348), and afterwards to the magnetic circuit of dynamos at the electrical conference at Philadelphia in 1884. The same method was also used in a paper by the same author on "Magnetic Permeability," in 1873 (*Phil. Mag.*, xlvi., p. 140). The following are some of the problems considered. To find the electromotive force necessary to make the electric current a sine curve in a transformer without secondary. To find the work of hysteresis. The mathematical difficulties to be overcome in considering the theory of the transformer are considerable, and Mr. Rowland thinks that they might be attacked in another way than his own, and perhaps with advantage; but he leaves the matter to be worked up further by other investigators.

The Starting of Electric Tramcars.

WE think Mr. Dolby misses the point of the question at issue. The determining factor is the *torque* on the rolling axle, and this for a given car and given conditions of road, &c., will be independent of the method of applying the power to the rolling axle. The question is, how to transmit this torque from the motor shaft; bearing in mind that the *time allowed to acquire a certain velocity is fixed!* Now there will be a minimum torque on the motor shaft, which will give the energy necessary to do the work in the given time, and consequently the car will not acquire the velocity quickly enough unless the current corresponding to this torque be flowing. The question is somewhat intricate at a first glance, but, really, it is simple enough; and if Mr. Dolby reconsiders it in the light of the above he will probably admit our reasoning. At any rate there are, so far as we are aware, no brake tests published on the relative merits of the two methods; but Mr. Albion T. Snell informs us that some four years ago he fitted a motor to a tramcar in Scotland which had friction gearing between the motor and the rolling axle, and that the power supplied to the motor was practically the same as that which afterwards obtained when the friction clutch was removed and an ordinary resistance frame used in its place. Indeed, the latter method was found to be better all round. The capital outlay was less and the parts liable to get out of order were fewer. Mr. Dolby is mistaken in imagining that the heat developed in the starting frames is sufficient to be of use for cooking purposes, &c. This is a worn-out joke and shows that he has not studied the subject very deeply. If the coils became very hot the heat could be utilised for warming the interiors of the cars. In America, where a starting resistance is invariably used, a special warming resistance coil is supplied in winter. The heat wasted in the friction clutch is not necessarily considerable, but if measured would be found to closely approximate to that spent in the resistance; from this point there is little to choose between the two methods. The quantity of electrical energy supplied to the motor is the real question, and this Mr. Dolby will find to be practically the same under both conditions.

Characteristics.

IN the New York *Electrical Engineer* Mr. Dobbie proposes to plot the total volts and total ampères for which a machine is designed, to an equal scale instead of making the volt and ampère scales the same. For machines of large output this is certainly a fairly good plan to follow, and it permits one to compare with ease the characteristics of machines of the same type but different outputs.

Dynamo Indicator.

Mr. G. T. MOLER has recently invented a useful little instrument for recording quickly the potential curve round the armature of a dynamo. It consists essentially of a very dead-beat voltmeter of small angular range, the needle of which moves over the surface of a smoked cylinder. The latter is rotated by the shaft of the armature in the same way as an ordinary speed indicator, and the voltmeter needle is made to press for about the time of one revolution on the cylinder. The terminals of the instrument must, of course, be connected to brushes pressing on two rings attached to adjacent bars of the commutator. The records shown are rather too small in the volt direction to be very satisfactory, but doubtless this can be improved on.

AMERICAN ENGINEERING NOTES.

THE UTILISATION OF WAVE POWER.

In the midst of such essentially practical papers as characterise American societies, the occasional advent of one of the type presented by Mr. A. W. Stahl on wave-power utilisation, reminds one of the Lancashire workman who, when his friend came to see him, and they had sat awhile in the best room, called to his wife, "Tak' 'em away, Mary; he knows we hav 'em"—*em* signifying the all and sundry mats, antimacassars, and general embellishments which Mary considered essential to that sphere of life and society in which it had pleased Providence to place her, but which her husband, of course, detested, though he was agreeable to permit their presence sufficiently long to prevent his friend's wife being informed of the lack of their conventional adornments. So with Mr. Stahl's paper, which tells us our American friends have such among them, though they do not wish them, as a rule, in evidence. While the grain in this paper has reference to some forms of mechanism for utilising the energy in ocean waves, it is preluded by a dissertation on wave forms and motion (more fitted for presentation to the Physical Society), the conclusions of which might have been utilised as an already built foundation on which to base the remainder of the paper, but which have too much the appearance of mathematical gymnastics to suit mechanical engineers.

The latter portion of the paper describes and illustrates diagrammatically various forms of apparatus for utilising the vertical rise of waves, the horizontal to and fro motion of particles at or near the suface, and the varying surface slope, and the difficulties in each case are pointed out. Then there is that class of machine which depends upon the actual translatory motion of waves rolling up a beach, the neatest form for which is a converging chamber with outlet valve, like the valve of the Montgolfier hydraulic ram. The author rightly concludes that the crux of the whole matter lies with some method of storage being feasible for distributing a uniform flow of energy from a variable source, and inclines to electric storage batteries, were these less costly.

It may be very well on the Pacific Coast of America, or on that of Australia, where a 6-feet tide is high, to use wave motors, but it seems more than likely that in Britain, where tides are higher, the actual tide itself is a better source than the waves, and though there must be a large storage of water to utilise tidal energy by driving turbines, the necessary heavy cost of these may be balanced by the smaller cost of electric storage, which need only be sufficient to supply the outflow of power between tides, for both the flow upward into a reservoir and the flow downward out of it, would turn a water wheel. Storage batteries are proving so satisfactory in distributing the work of windmills that they may well be hopefully considered in connection with the utilisation of tidal energy, especially as there are as many as four maxima daily, and an entire cessation only at extreme high or low water, when the fall potential would be too low for economical use.

If we could count on an average fall of 10 feet, and an 80 per cent. efficiency, we should require something like 35 cubic feet of water storage per minute per horse-power, on the basis of the equal utilisation of an average of 10 feet of the up-flow. Anyone sufficiently interested can make the calculations for various conditions. The author of the paper, when referring to storage, inclines for water, to highly-placed reservoirs filled by pumps actuated by the wave motors, but he would distribute such stored energy through the ultimate agency of electrical appliances.

In conclusion, he refers to the large proportion of wave motor patents which hail from California, where fuel is dear and wave motion is more continuous and equable than in other localities, as on the Atlantic coast. The main interest in the paper is its bringing under one cover the various methods which have been suggested for dealing with the subject. So far, the mechanism bears about the same relation to what will ultimately prove successful, as did the original Otto and Langen gas engine to the present day compression gas engines. There is something wanting in them all, except the tidal reservoir, and in that there is too much, we fear—too much expense for the energy to be got out of it, except in isolated cases, where a small expense will bank up a large mass of water; and even in these cases the inlets for the water would involve very costly works.

TOPICAL MATTERS.

A good feature in American societies is the topical questions. Many of those for discussion at the San Francisco meeting, and there were 21 presented, were extremely suggestive, and they comprise a large number of branches of mechanical engineering. No. 101, for example, asks:—"Is there any best way of grouping tubes over the cylindrical furnace of a Scotch boiler?" by which we suppose a return tube marine boiler is intended. This raises the whole question of tube grouping in vertical or staggered lines, and of their obstruction to water circulation, and possible causes of tube plate troubles, and from the facts elicited, something should be learned. We have often wondered how much effect the rolling of a vessel at sea must have in saving tubes from burning and facilitating circulation. Are there any facts, for example, to show that in a dead smooth sea, such as is often the case with a steamer between the Leeuwin and Aden, there is more tube trouble than in more lively weather. No. 100 asks concerning a circulating device for use in similar boilers. It would occur naturally to most of us that, with a constant forced exchange of water between the surface and the bottom, the temperature must be made even, and an upward current established which would sweep the tubes of steam as fast as formed; but in our opinion, the best current to set up in a boiler is one across the tubes, which should sweep to a central open space, up which the current should then rise to the surface with merely a surface deflector, to turn the hot current over the whole water area.

Question 97, relating to chimney sizes for boilers of ordinary type and of the water tube form, appears as though based upon a misconception of the action of a chimney, or a desire to bring out an expression of such from those joining in the discussion, for it appears to assume that a chimney is a source of energy, and to endorse the popular idea that a chimney has a drawing action. This, of course, is quite erroneous. A chimney only isolates, and prevents the dispersion of, a column of hot gases, and *draught* is but an expression which is used to describe the action of external cold air falling into this isolated space because of its greater gravity. Hot gases, in short, do not rise, but cold gases have a gravity superior to that of hot ones, and force their way beneath them. In a furnace, therefore, the chimney area has merely to take so much volume of gas whatever the kind of boiler, and the draught of two boilers fitted with similar chimneys is a measure of the resistance offered by the passages through the boiler to the flow of air. If one boiler offers more resistance than another, it will be said to have a poorer draught, and an endeavour may be made by increasing the internal diameter of the chimney, so as to reduce its resistance, to bring the sum of the resistance of boiler and chimney equal in the two cases. In this way only can two boilers be said to require different chimneys, when in respect to grate areas they are similar, and give off equal volumes of gases per pound of fuel burned. If attached to the same chimney and placed under equal conditions as to position, it would be found that one boiler would have a draught very different from another. In fact, this is a matter of daily observation, despite the intended equalising effect of mid-feathers, &c., and is one of the strongest arguments against the obsolete ideas of small flues with the intention of compelling the hot gases to hug the boiler plates more closely.

"Has anyone tried sand blasting cast-iron to prepare it for nickel plating?"

"Which is the best method for renovating old files, sand blasting, etching, or recutting?"

"What methods do you use to determine the cost of manufacturing products?" &c., are samples of the questions for discussion; and the last on the list is, "If the suction to a pump comes to it under a pressure, will the pump deliver more than its piston displacement. If so, how much?" Of this question it may be said that it hints at the common notion that all pumps have slip, and do not deliver as much as their theoretical quantity. Now this is a mistake, for a pump which even "draws" its suction from several feet below and is worked by a handle, will deliver more than its

capacity. It would be queer if it did not do so, for in a suction pipe, say, of 20 feet in length filled with water, the up-stroke of the pump bucket allows the water to move upward in the suction pipe by removing the atmospheric pressure above, and a 20 feet moving column of water is not to be stopped instanter. On the contrary, it obeys that law of motion which says that a body in motion will keep in motion until stopped by an opposing force, and this is what water does, for it moves forward through the retaining clack of the pump during the down stroke of the bucket, so that in a pump of 6 inches stroke, a length of 6½ inches may be delivered each stroke, or even more.

With double barrel pumps worked by a crank shaft this action is very noticeable, and it forms a strong argument against heavy pump valves, and in favour of rapid action and large valves, though perhaps, also, it is an argument against large suction pipes. In a pump, the object must be to keep the water in motion in one direction. The downward push of the bucket is resisted by the push upward of the column of moving water instead of, as in a slow pump, by the retaining valve, and the bucket should be of such form that its downward stroke is made with as little resistance as possible. The amount delivered in excess of mis-called theoretical capacity depends, of course, upon the velocity, v, of up-flow in the suction pipe, and the period of time, t, occupied during the down stroke, and will be greatest when t v is a maximum, and will vary with dimensions. Artesian well engineers, who have so much practice in testing the yield of wells, recognise the principle of continuous flow, and have long done so, perhaps because with small test pumps they employ quick speeds in order to obtain quantity, and so approximate to the conditions necessary to secure continuity of up-flow. Similarly, of course, the gravitation of water to a pump must increase its flow according to the velocity in the suction pipe during the period of back stroke; for, if not, what is the principle underlying the action of the hydraulic ram? The practical results of many mechanical appliances differ from the theoretical results, not by virtue of anything which renders practice and theory incompatible, but because the so-called theory has failed to recognise the elementary principles of the science of which the false theory is the professed exponent.

A Power Meter.

There is still a demand for a good power meter which shall measure the power transmitted through a belt or shaft and automatically record it. Continuous indicators of most ingenious design have been applied to the steam engine cylinder, but are useless as an indication of power delivered, say, to half-a-dozen different customers.

In Lancashire, and other manufacturing districts, it is quite common for a mill-owner to let rooms with power to small manufacturers, so that there may be a dozen small users supplied by one engine. Where it is a question of so many looms, cards, or spindles to be driven, it is customary to charge accordingly, so much per loom per week, or so much per 1,000 mule spindles; but the result is not always fair, and a case came under the writer's notice where an agreement per loom proved very costly to the finder of the power, for the loom owner was one who wove with very tight warps, and put so much drag upon the warp beam that the driving of the looms consumed more fuel than paid for. A paper appears, amongst others presented to the American Society of Mechanical Engineers at San Francisco, which describes a form of dynamometer to be used for measuring either the power used by a given machine, such as a dynamo, or to measure the total power given out by the engine. A brake will do this accurately, but no other work can be done at the same time, and power recorders must take no power themselves.

A meter described is that illustrated in fig. 1. B is the crank shaft of an engine. Suppose that shaft, and the driving pulley, P, is connected to the shaft by means of four links, E, M, F, N, connecting the cross head to a pair of double bell-crank levers, K, L, O, and C, D, G, mounted on bearings fixed to the pulley. The ends of the arms, O and G, bear against one end of a rod, R, passing along the axis of the hollow shaft of the pulley. When the shaft, B, is turned, two of the arms of the cranks, as F and M or E and N, are pulled toward the cross head, and thus tend to push the rod, R, outward. This is resisted by the bell-crank lever, S, which is supported by a plate resting on a diaphragm which closes the top of the cylinder, T. The cylinder, T, is either partly filled with mercury and partly with water, or filled with water and piped to a mercury or other form of pressure gauge. The pressure on the end of R is thus resisted by a

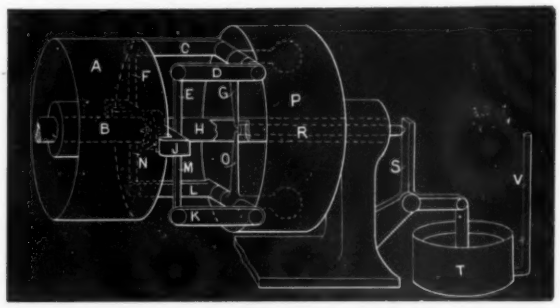


FIG 1.

column of mercury, the height of which will be directly as the pressure, and inversely as the size of the plate resting on the diaphragm. Thus, by finding the indication of the gauge, when a known pull or push is applied to S at the point of contact of R, the turning moment exerted by the engine can be calculated for any value of the reading on the gauge. The effect of centrifugal force on the levers attached to the pulley, P, must be eliminated, and this is done by counterpoise masses applied as indicated by the dotted lines inside the pulley.

Permanent records of the indications may be easily obtained by many ways which will suggest themselves to engineers accustomed to self-recording apparatus.

When used for measuring the power absorbed by a single machine, P becomes the pulley driven by the power transmitting belt, and J is clamped, as shown in the figure, to the pulley, A, of the machine to be indicated.

In another form described (fig. 2) the driving belt is

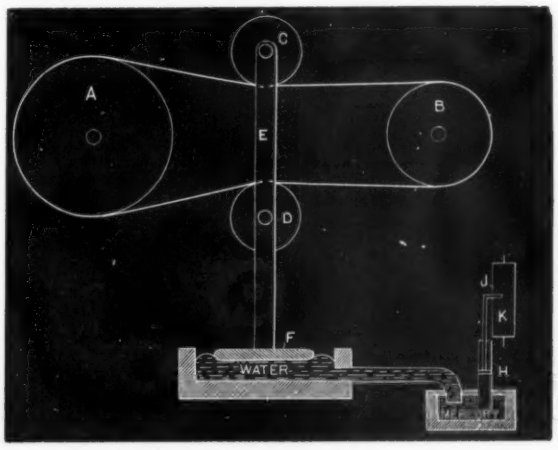


FIG. 2

drawn together by a pair of pulleys, C and D, mounted in a frame, E, which rests on a plate, F, and if the lower side of the belt is made the driving side, it is evident that an increase of power transmitted will slacken the upper or slack side, and increase the downward pressure on the diaphragm plate. This seems better than the first type described, for we should feel inclined to doubt the sufficiently easy working of the levers, C, D, and L, K, of fig. 1. The same methods of recording the diaphragm pressure may be applied to the type of fig. 2 as to the former type of meter.

A third form described is very interesting and ingenious. It takes cognizance of the fact that owing to the stretch of a working belt the weight of a foot of tight side belt is less than the weight of a foot of slack side, and yet the same total weight of leather passes every portion of the belt's path in the same time. This proves the velocity of the stretched belt to be greater than of the unstretched, and the work of stretching is measured, *i.e.*, the actual stretch, is measured by

running against the belt on its tight and slack sides two pulleys, C and D, in fig. 3.

One of these is geared down to drive a graduated disc, and the other drives an index finger which will travel round the disc in the same direction. If there is any relative motion between the disc and finger it is proof of so much belt stretch, and if once standardised, the belt, if of good homogeneous material worked within its elastic limit, will show a stretch corresponding with the tension in it. This dynamometer is, in fact, really a meter of the belt stretch or a differential recorder.

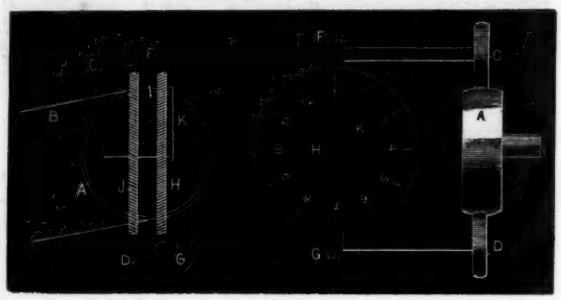


FIG. 3.

In fig. 3, which shows simply a diagrammatic form of the instrument without reducing gear between belt and index, B is the belt to be indicated, and C, D, the integrating discs carrying worms, F and G, to drive the face plate, H, and the finger, K.

Of course, in an actual instrument the dial would remain at rest and the finger would have a motion compounded of the motions of both integrating discs.

The same principle may be applied in scores of methods, as in the recording of the torsion angle of a shaft transmitting power, and a trial might be made with a helical spring transmitting power as a shaft.

The tendency would be to wind or unwind the helix, whose opposite ends would thus have a relative angular movement, which could very readily be measured, whilst use might even be made of the variation of the diameter of the helix under different torsive stresses.

The transmission of power through any material of uniform texture seems quite capable of being measured with a reasonable accuracy, and the method of fig. 3 lends itself readily to the portability of the instrument, a most important practical consideration not always sufficiently considered by inventors.

THE "T.-H." FACTORIES, LYNN, MASS., U.S.

THE *Electrical Engineer*, of New York, published last month an interesting article by Mr. A. C. Shaw, giving a brief history of the Thomson-Houston Company, and describing at some length the present factories and the system of management.

This company was originally formed in 1880 in New Britain under the name of the American Electric Company, to manufacture arc light dynamos from the designs of Prof. Elihu Thomson and E. J. Houston. In 1882 most of the stock fell into the hands of the Brush Company, who, however, in the fall of the same year allowed it to lapse into the hands of certain Lynn capitalists. These gentlemen, headed by Messrs. Pever, Barton and Coffin, re-organised the business, and changed the name to the Thomson-Houston Company. In a short time a factory was secured in Lynn, and in 1887 the business was transferred to the new site. Since then the transactions of the company have steadily increased, and new branches have been added from time to time, including direct incandescence, alternating incandescence, motor, and railway work, and, lastly, the mining department. The factories now occupy 342,000 square feet or about eight acres. On May 8th, 1888, the share capital was increased to $1,000,000; and it ultimately reached $18,400,000, at which stage it was emerged into the Edison General Electric Company, the combined businesses constituting the General Electric Company. It is difficult to thoroughly grasp the extent of the T.-H. factories, or to gauge the enormous quantity of work they turn out. The numerous illustrations in the *Electrical Engineer*, however, give some idea of the scale on which electric machinery is built, and also a fair glimpse of the sub-division of the department, and the method of carrying on business.

To the casual observer, probably the most interesting part of the whole is the private department of Prof. Thomson. This is a laboratory fitted up as a genuine workshop, in which some half dozen skilled workmen assist the professor to develop his ideas and perfect the intricate details of new schemes. The power house or testing room, as we should say, is replete with apparatus for making tests up to 500 horse-power, and contrasts strangely with the testing departments of most English firms.

All the factories are connected by telephones and electric tramways, served by electric cars; while the freight yard has an electric locomotive for handling the trucks.

The reception and general management offices are in keeping with the rest of the arrangements; the office of the production department, however, is worthy of special mention. Mr. D. M. Barton is the manager, and with his staff of clerks sees that the proper production of apparatus is maintained, and that a sufficient supply of new material is ordered and received. This is, of course, only the ordinary duty of someone, whatever his title may be, in every factory; but the T.-H. method of ensuring dispatch and obviating delays in the works is certainly original. Around the "production" office a number of boards are fitted up. Each of these is sub-divided into columns, each having a number of small holes, into which are inserted little plugs bearing the number of the piece or part of machinery, representing, say, an armature, field core, or, in some cases, a complete dynamo or motor. For example, the railway board is divided as follows: At the left hand is a column showing the motors ordered, the class and the destination. At the right hand is a column marked "fields set up;" next are "shafts inspected," then "cores," another "winding," one "wound," one "connected," "baked," "in car house," and the last column is endorsed "ready to ship." As the parts of the motor move along ready towards completion, the little plugs are changed from column to column until they finally come to the one marked "ready to ship."

In this way the manager can see the approximate state of each job, and so judge of the general dispatch, and note when "urgency" is required.

NOTES ON THE DOUBLE DIFFERENTIAL RELAY FOR USE ON SUBMARINE CABLES.

BY EDWARD RAYMOND-BARKER.

THE object of these notes is to give an account of work undertaken by the writer in the direction of Submarine Cable Automatic Translation. These practical researches, which only date from the middle of last June, were—the writer hastens to affirm—wholly suggested by the ingenious submarine cable relay invented by Mr. Charles Cuttriss, and lately described in the New York *Electrical Engineer*, and subsequently in the English electrical journals.*

Although a successful submarine cable relay would necessarily appear to involve equally successful automatic translation from one cable to another, Mr. Cuttriss's brilliantly conceived carbon-helix Wheatstone-balance system seems, so far, to have been found practically applicable solely to local circuits, whether these be considered as confined to an instrument-room, or be taken as including various branch offices throughout any city into which a main cable circuit may be brought.

Our idea, then, is to develop a practically feasible system for translating the weakened electrical impulses received from one long cable, not into a comparatively short circuit as above suggested, but into another long cable. Experiments performed with crudely constructed apparatus point to this

* ELECTRICAL REVIEW for July 1, 1892.

development being a decided step towards the realisation of submarine automatic translation. Before, however, submitting these notes to the editor and readers of the ELECTRICAL REVIEW, the writer would have awaited further experiments with better apparatus, were it not that, interest in this question having become widespread, any little contribution towards the general stock of information is well timed.

To facilitate reference, we give a simple diagram of the Cuttriss relay. (See fig. 1.) A freely suspended coil energised from a cable, actuates carbon helices, H, H′, which, with adjust-

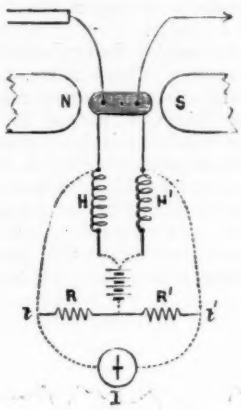


FIG. 1.

able resistance coils, R, R′, form the four arms of a Wheatstone balance. I, is the instrument on local circuit actuated by variation of potential between points, t, t', caused by compression and expansion at H, H′, due to coil deflections.

Fig. 2 shows how what may be termed Mr. Cuttriss's *single differential* arrangement of carbon helices may be doubled in efficiency per unit of coil-deflection, by being converted into a *double differential* system. Here the coil actuates

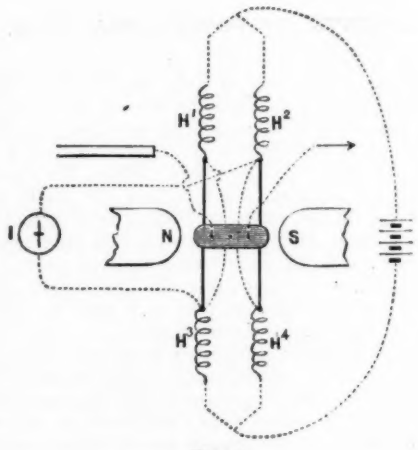


FIG. 2.

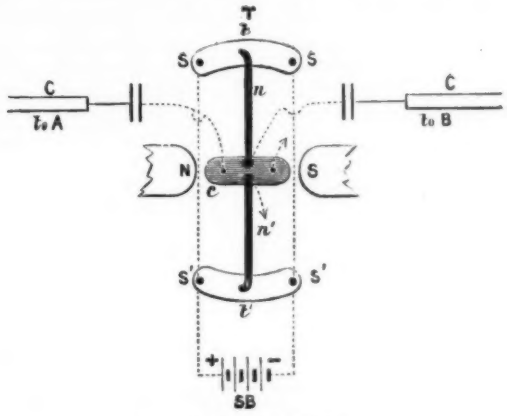
four carbon filament helices, H^1, H^2, H^3, H^4, which are the four arms of a Wheatstone balance. A deflection of the coil in the direction of the hands of a watch compresses H^1 and H^4, and expands H^2 and H^3, whilst a deflection in the opposite direction just reverses matters. The bridge terminals of the circuit, I, are thus subjected, by the reversals of the signalling coil, to opposite differences of potential exactly double those obtained with the single differential system.

It is clear that in view of balance and other adjustments, rheostats may be included in any, or in all of the arms, but if, when using the double differential system, we require the maximum effect per unit of coil deflection, the added artificial resistance ought to be the minimum actually required for re-adjusting deficiencies due to electrical inequalities in the carbon helices. Any artificial resistance over and above this, simply decreases the percentage of variation in the arms per unit of coil-deflection. The four carbon helices may, at pleasure, be connected so as to form two arms of the balance, the other two arms of which are adjustable-resistance coils, but this single differential plan has little to commend it over that of Mr. Cuttriss, unless it be the increase of carbon-resistance variation, and the improved mechanical balance of the suspended coil thus subjected to equalised helix tension at both its faces or poles.

With a view to applying the Wheatstone Balance to automatic translation from one long submarine cable to another, the writer has devised a system possessed of the following attributes :—

1. It is doubly differential.
2. It is productive of larger variation of potential per unit coil deflection than that obtainable by the compression and expansion of carbon helices.
3. It is convenient as a medium for varying resistance when actuated by coil movements.

The writer's double-differential relay translator* above alluded to, is shown diagrammatically in fig. 3.



C, Cable; T, Translating station.

FIG. 3.

No adjustments are shown in this diagram which is merely theoretical.

C is a coil freely suspended in a magnetic focus, and connected, as usual, between the receiving cable and earth. C carries a light metallic needle divided in halves, n, n', electrically insulated one from the other. The further ends of the two halves, n, n', bend with non-oxidisable tips, t, t', into, and make connection with, liquid contained in two troughs, s, s, s', s', of insulating material, these latter being segments of a circle extended from that in which C itself deflects. Needles, n, n', are connected, at their butt-ends, respectively to the transmitting cable and earth. Adjustable and non-oxidisable contacts at outside ends of s, s, s', s', are connected in multiple to the + and − poles of a battery. We can now imagine a uniform fall of potential along each of the two liquid segments, *i.e.*, along s, s, and s', s', respectively. As long as C is undisturbed, the needles, n, n', tap, so to speak, equal potentials at t and t', no flow consequently taking place between t and t', *i.e.*, to cable B and earth. In other words, n, n', divide s, s, s', s', into the four arms of a Wheatstone balance, and the battery connections on s, s, s', s', may, at pleasure, be reversed with those on n, n'.

When, in fig. 3, C is deflected by a current received from A, the needle, n, moving, say, to the left through the liquid, taps s, s, at a much higher potential, whilst needle n, moving to the right, taps s', s', at a much lower potential, this doubly differential effect bringing about a strong flow of current between needle tips, t, t', and along cable to station B. When n moves to the right, and n' to the left, the reverse takes place, and an impulse of opposite sign is transmitted to B. Battery, S, B, is adjusted to a voltage conformable with the strength of impulse required to produce good signals at B.

The series of varying potentials which go to produce signals received from A are, in fact, reproduced, though, in a magnified form, and actuate, through the transmitting cable, the mirror or recorder at B.

* Provisionally protected.

Artificial resistance can be added to any of the liquid segments for adjusting purposes, but this will not be required, especially as the base on which the troughs, s, s, s', s', are fixed, can itself be rotated on its centre through any angle on a horizontal plane. Other adjustments permit of more or less liquid being included in the two derived circuits, whilst arrangement is made for storing liquid in view of evaporation at s, s, s', s'. Trouble due to electrolysis was expected, but results show that this is no insuperable drawback.

The relay translator may be made separate from the receiving instrument, the coil of which can be connected to the needle system of the differential relay by a fine silk fibre with, or without, a multiplying lever. A multiplier increases the deflection of the needle, and consequently increases the variation of potential per unit of coil deflection.

Fig. 4 shows a specimen of signals from the double differential liquid relay, actually received through an artificial cable of 3,200 ω, total C.R., and 426·4 mfds., total I.C., equivalent to 1,421 nautical miles of cable 2·25 ω.* and ·3 mfd. per nautical mile. A signalling condenser of 80 mfds. was inserted at each end of the artificial line. Very fair signals were also obtained through an equivalent to 1,700 n.m. of cable. The receiving instrument used was a siphon recorder, clockwork pattern, with a Dickenson vibrator attached. The sensitiveness of the signalling coil was small, the weight fibres, as the instrument stood, being far apart.

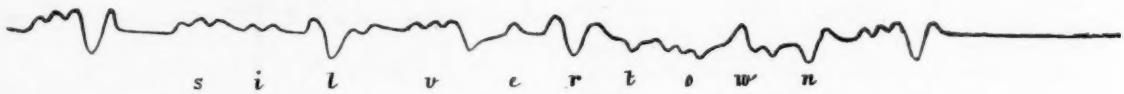
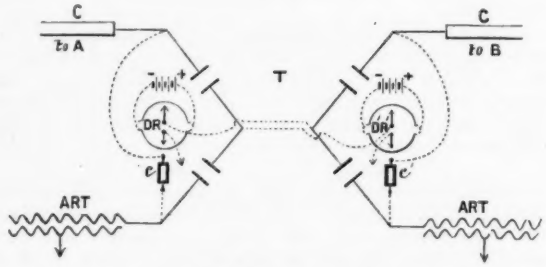


FIG. 4.

The battery connected to the liquid segments was of 50 volts.

Under certain conditions the differential relay influenced by a very weak cable impulse could actuate a Brown-Allen relay fitted with a contact on each side of the tongue, the deflections of which would work, on local circuit, two



C, Cable; T, Station; A R T, Artificial.

FIG. 5.

sounder translators, the two armatures of which would transmit, like any cable key, positive and negative signals direct to line from a sending battery.

When working cables simplex, a multiple switch is controlled at the translating station, T, by an operator who watches the working of the relay, either from the needle, or, more conveniently, from a "spot" of light reflected from a mirror placed on the relay axis, on to a rather extended screen or scale; or the range of deflection of the luminous ray could be contracted within the limits of a short scale by suitable lenses. To allow of translation in both directions, this multiple switch interchanges the receiving and the translating terminals of the differential relay with the two cable circuits, A and B, respectively. When cables are "clear," the switch connects them to the relay coil, so that a call from either cable advises the operator at T to turn the switch for automatic translation to proceed.

The multiple switch could also, at pleasure, join up a recorder for the reception of local work, or, better still, a differential relay might be fitted to an ordinary recorder, the signalling coil of which would actuate, by fibre adjustment, the siphon in front of the instrument, and a differential relay behind, so that the apparatus would record and translate simultaneously. This plan would be useful where there was much local traffic.

In *duplex* working, purely automatic duplex translation can proceed as in fig. 5, without any intermediate manual switch being required; though a little supervision on the part of an operator might be desirable.

In fig. 5, the suspended coil, c, actuates a differential relay, D, R, which translates to B duplex, whilst c' actuates D', R', and translates to A duplex.

The writer apologises for the crudeness of the above notes, hastily thrown together. They relate, however, to experiments which, rough though they be, more than suggest a grand future for this new method of translation. Mr. Cuttriss has given this ball a brilliant start, and we hope that the double differential plan will give it fresh impetus. As regards carbon *versus* liquid, both have their advantages. Carbon helices would appear the better contrivance for relays working local or short circuits, whilst the liquid system, with its greater variations of potential along the high resistance liquid segments, is better adapted for translation between long cables.

The writer hopes to shortly give an account of results to be obtained from new and exact instruments designed from experimental data.

* This C.R. is low, but no difference was noticeable in the signals when an extra 20,000 ω. was inserted in cable circuit.—E.R.B.

POINTS IN POWER STATIONS.

IN the *Electrical Engineer* of July 6th, Mr. Lee Church has some correspondence on the above subject, and with much of what he has to say it is not difficult to agree. On one point, especially, he is very much in the right, and that is the proportion of boiler power necessary. When Mr. Church confesses that he is a steam engineer, and yet boldly confesses also that he did not foresee any better arrangement than to put four boilers each of 60 H.P. capacity to drive two engines of 100 H.P. each maximum capacity, in an electric railroad power station, we admire his pluck and despise his judgment, for he did not see the folly of it until he found that two boilers would do all the work easily. If some electrical engineers had their own way, they would use boilers holding about a tenth the proper quantity of water, in utter disregard of the fact which Mr. Church sees now so plainly, that the steam boilers of a station merely require to be large enough to turn out steam at the *average* rate of daily consumption, but that the engines must be big enough to give the maximum power required, even if they carry steam full stroke to do it. Of course, the average rate of steam consumption per horse-power is necessarily high, and the boilers must be proportioned to give steam for this same high rate, but not for more than this; for with a proper water capacity, the inertia of a steam boiler is large, and will enable it to yield steam to carry on over high points in the energy diagram, and absorb heat from the furnace at periods of comparative idleness.

These points have been drawn attention to in the columns of the ELECTRICAL REVIEW, specially with reference to the advisability of carrying large amounts of water. The advocates of boilers with small water capacity are very apt to conclude that rapidity of steam generation implies economical performance, and go so far even as to state that when a station ceases work for the day, the stored heat in a large bulk of water is lost, quite forgetful that during the last

few minutes of working, the fires will have been let down and steam dropped to its minimum, and the water level also allowed to run to a minimum, and they further overlook the fact that the smaller the water capacity in a boiler, the more nearly must the heating surface and furnace capacity approach to that corresponding with the engine-power necessary to pull over the high points. Where the water capacity is zero, as it may be considered in that proposed boiler wherein water is injected upon heated surfaces and the whole is flashed into steam instantly, then it would clearly be necessary to maintain a maximum fire and maintain it, too, right up to the last instant of work. In what he has to say of boilers, Mr. Church now appears to have a clear insight into the matter and to have profited by the error for which he states he was a bit ashamed. He was in good company, however, in his error, for if the evidence against the proposed Central Subway Railway in 1889 be referred to, it will be seen that a noted "Sir" scientific witness, whose absolute veracity it would be flat blasphemy to doubt in the least, did not appear in his evidence to be at all clear in respect to proper allowances for varying loads.

We cannot, however, agree with Mr. Church that engine capacity must be determined without reference to condensation, when present; to neglect the power given by condensation is practically to allow of a more serious underloading than already compulsory, and where there is a sufficiency of condensing water there need be no occasion for the condenser to become choked, disabled or leaky, or to lose its vacuum under a sudden fluctuation. Any detail may become disabled, but there is no reason more for fearing this of a condenser than for any other part, and as to losing its vacuum, through overheating (which we assume is what Mr. Church means), the same arrangement which gives a sudden accession of steam to be condensed can at least be made to give a sudden accession of water wherewithal to condense that steam, and, too, at least one stroke ahead of the advent of that steam to the condenser. To neglect the condenser is by no means a corollary of the action of the steam engine, for the injection valve is as easily regulated automatically as are the steam admission valves, only it is not so often done, because, ordinarily, steam engines work at fairly regular speeds and powers, and the injection valve is opened by hand by the engineer, who keeps his eye on the vacuum gauge as he does so, and usually gives a little more admission of water than he finds is sufficient to maintain a full attainable vacuum. Mr. Church's remarks here savour just a trifle of that rule of thumb, which he condemns when properly denouncing the errors in choice of boiler capacity.

Mr. Church makes the reservation that his remarks anent relative capacities of engine, boiler, and dynamo at what we may term a proper standard rating of each, are to be more especially understood as applying to small stations, rightly concluding that over a large system actuated from one station the chances are in favour of a far more close approximation of maximum and minimum load to the dead level of the daily average than can be the case on a small road of a few cars only. With numerous cars, the expenditure of energy will be in all likelihood extremely regular, and within the economical limits of variation of the engines, whilst, of course, the boiler capacity will be simply that of the engines. For small stations he inclines, however, to the proportion :—

Dynamo	...	...	100
Engine ...	...	...	100
Boiler ...	...	...	60

for he considers the dynamo, like the engine, may for any short periods be run above its proper rating, as it will not become dangerously over-heated in the short period of maximum effort.

It may not be an easy problem in mechanics to solve, or even within the range of practical possibilities, but one of the best methods of getting an engine to do more work with economical rates of expansion would be to so arrange the driving connection between the engine and dynamo that the speed of the engine could be augmented for the higher powers whilst keeping that of the dynamo constant. The change would require to be so quickly effected that it is not clear how it could be carried out.

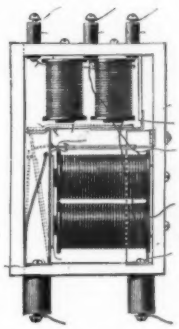
Mr. Church considers 20 to 25 per cent. the outside excess above its rated capacity to which an engine should be made to work. Even with this the engine must be enormously too large for its minimum duty, which may be *nil* on the ampère diagram, and he gave illustrations in the original article to which he now refers, of some indicator diagrams showing 33 per cent. overload above normal; but as no scale or other figures are given, we cannot compare any of the diagrams fairly, or know if the standard diagram was such as to commend itself to our judgment; but our impression from this appearance is, that the normal load is a heavy one, and the true rated capacity less than that allowed, so that the maximum load is really more than 33 per cent. above a proper normal.

Considering how short is the actual period of maximum load, it almost seems that the engine capacity should be such as to just overcome the maximum load with steam carried full stroke in the cylinder. This may not be economical, but the loss due to a few cylinderfuls of steam thus expended will often be less than the long continued loss consequent on so much running at almost a friction-diagram rate of work.

THE SECHRIST AUTOMATIC CONTROLLER FOR INCANDESCENT LIGHTS.*

A VALUABLE patent was granted to Albert Sechrist of Denver, Col., on the 7th day of June, which covers a new system of controlling electric lights. The system is similar to that used in electric gas lighting and, in fact, answers the same purpose for controlling electric lighting as the automatic gas burner. The system is a combination of an automatic switch, push buttons and an ordinary battery, or shunt circuit. The automatic switch answers the same purpose as

FIG 1.



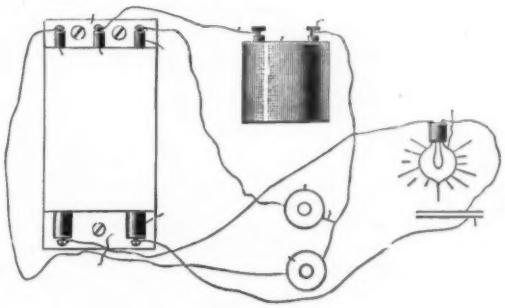


FIG. 2.

an ordinary switch, but instead of being operated by hand it is controlled by push buttons the same as gas keys located at any number of different points. The switch is simple in construction as is seen by reference to fig. 1, while fig. 2 shows the whole circuit. The white buttons operate a magnet which turns on the light, and the black buttons operate a similar magnet which releases a spring and turns off the switch. The system is especially adapted for residence lighting, and in that capacity gives a great range of possibilities. The switches are located in some out-of-the-way place and only the neat and ornamental push buttons are to be seen, located conveniently on the door casing at the entrance to the various rooms. Besides presenting a much

* New York *Electrical Engineer*.

neater appearance, the same light may be controlled from any number of different points. This is often a great convenience : take for example the second-storey hall light, which may be operated from the first, second and third storey halls and also from each of the chambers on the second floor. In this way a person may pass through the house in any direction without the necessity of ever being in the dark, as by simply touching a button, here or there, it will turn on the light ahead or extinguish the light no longer needed.

A set of buttons may be located in the chamber to control the entire house. The porch, hall, parlour and library lights may be controlled from the front and side entrances. The system is also useful as a burglar alarm ; the wires may be attached to the ordinary burglar alarm system of the house and whenever a door or window is open the light is automatically turned on, to the utter rout and confusion of the burglar ; or the wires may be attached to an ordinary clock, the light will then be turned on or off at any desired time.

Although the system has only been in use six months in Denver, over 50 residences are being lighted with the Sechrist automatic switch, and the prominent architects are specifying the same for new residences that are being built.

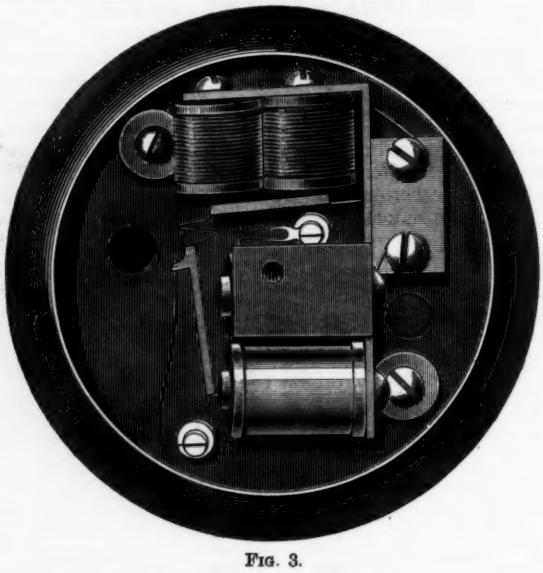


FIG. 3.

Fig. 3 shows a new and very convenient form of the switch, with regular metal cap screwed on, and the whole mounted on a fine porcelain base. In the engraving, the cap has been removed. The screw holding the cap engages in the small hole shown in the flat leaf covering one of the magnet spools.

EFFICIENCY OF THE LAUFFEN-FRANKFORT POWER TRANSMISSION PLANT.

THE Committee of Experts have now published the figures of eleven tests of the Drehstrom plant between Lauffen and Frankfort. The detailed description will be made when the official report of the Committee is published ; in the meantime, however, some useful information may be gathered from the figures as they stand. The tests were made on six different days, and the atmospheric conditions were noted and remarks appended under the several dates. We are indebted to an article in the *Electrical World* of New York, by Carl Hering, for the copy of the tests and also for the several curves shown in figures 1 and 2. The information is sufficient to prove, without a doubt, that the tri-phase system is admirably adapted for the efficient transmission of power through long distances, and the difficulties of self-induction and capacity of the line have, in this case at any rate, apparently cancelled out.

It will be fresh in the memory of readers of the ELECTRICAL REVIEW that the line was composed of three bare copper wires, four millimetres in diameter, and each 108·6 miles in length, so that the resistance of each conductor was, approximately, 200 ohms. The total resistance of the three wires, assuming the current to return by two wires in parallel would, therefore, be about 300 ohms. The loss in the line in the eleventh test is stated to be 25·2 horse-power, or 14·2 per cent. of the energy given out by the step-down transformer. Since we do not know the current flowing in the line, it is useless to make guesses as to how much of this quantity was spent in overcoming the ohmic resistance and how much was absorbed in leakage, static and induction losses. It is to be hoped that the official report will give full data, so as to enable these points to be satisfactorily cleared up. Just at present we must be contented with the relative efficiencies of the different factors of the plant and notice especially the grand net result.

In fig. 1, which compares the horse-power delivered by the various factors of the plant with that given out by the tur-

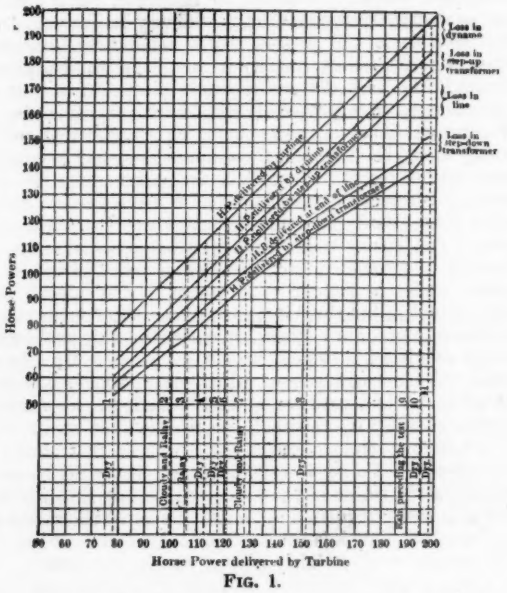


FIG. 1.

bine, we see that the output of the dynamos and transformers follows nearly a straight line law throughout the limit of the test. The loss in the line, of course, steadily increases with the load ; but, at about an output of 189 H.P. on the turbine

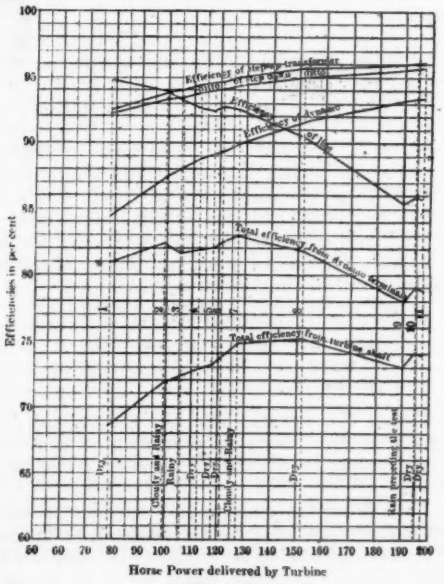


FIG. 2.

there appears to be a sudden increase in the power lost in the conductors. This is probably due to leakage, since the weather was wet at the time of making this particular test. Also, there is no trace of any departure from symmetry in the dynamo or step-up transformer ; but the receiving transformer, of course, shows a corresponding dip, for it received less energy under these conditions.

Reference number.	Date and time, October, 1891. (Each test lasted 10 minutes).	Horse-power delivered by turbine*	Horse-power delivered by dynamo.	Horse-power delivered by step-up transformer.	Horse-power delivered to step-down transformer (after transmission)	Horse-power delivered by step-down transformer to lamps.	Loss in line in horse-power.	Loss in line in per cent.	Efficiency of the dynamo, in per cent.	Efficiency of the step-up transformer, in per cent.	Efficiency of the step-down transformer, in per cent.	Total efficiency of the transmission from dynamo terminals to place of consumption, in per cent.	Total efficiency of the transmission from turbine shaft to place of consumption, in per cent.	State of the weather.
1	12th, 2.30 P.M.	78·2	66·1	61·1	58·0	53·5	3·1	5·1	84·5	92·5	92·2	80·9	68·5	Dry.
2	,, 2.10 P.M.	99·3	86·8	81·5	76·5	71·4	5.0	6·0	87·4	93·9	93·3	82·4	71·9	Cloudy frequent rains.
3	13th, 9.50 A.M.	105 9	93·3	87·7	81·7	76·3	6·0	6·8	88·1	94·0	93·4	81·6	72·1	Rain till noon.
	,, 10.05 A.M.	105·9	93·3	87·7	81·8	76·4	5·9	6·7	88·1	94·0	93 4	81·7	72·2	
4	,, 1.45 P.M.	112·7	100·1	94·5	87·6	82·2	6·9	7·3	88·8	94·4	93·8	81·9	72·9	Dry.
5	,, 1.30 P.M.	117·6	104·9	99·2	91·7	86·2	7·5	7·5	89·2	94·6	94·0	82·0	73·3	Dry.
6	11th, 1.30 P.M.	120 9	108·1	102·4	95·1	89 5	7·3	7·2	89·4	94·7	94·1	82·6	74·0	Clear, dry.
	,, 1.50 P.M.	121·1	108·3	102·6	95·0	89·4	7·6	7·4	89·4	94·7	94·1	82·4	73·8	
7	12th, 1.35 P.M.	127·0	114·4	108·7	100·7	95·1	8·0	7·4	90 0	95·0	94·4	83·0	74·9	Cloudy, frequent rains.
	,, 1.50 P.M.	127·5	114·8	109·0	100·9	95·3	8·1	7·5	90·0	95·0	94·4	82·9	74·8	
8	14th, 10.15 A.M.	151·8	139·1	132·8	120·0	114·0	12·8	9·5	91·6	95·5	95·0	81·8	75·1	Dry.
	,, 11.00 A.M.	151·7	139·0	132·7	120·2	114·2	12·5	9·4	91·6	96·1	95·0	82·0	75·3	
9	,, 11.20 A.M.	189·7	177 0	169·9	145·3	138 9	24·6	14·4	93·3	96·0	95·6	78·1	73·2	Rain in the morning.
	,, 11.50 A.M.	190·0	177 3	170·2	145·3	138·9	24 9	14·6	93·3	96·0	95·6	78·1	73·1	
	15th, 10.53 A.M.	190·7	177·9	170·8	145·3	138·9	25·5	14·8	93·3	96·0	95·6	77·8	72·8	
10	,, 11.35 A.M.	194·7	182 2	175·1	150·7	144·2	24·4	14·0	93·5	96·1	95·7	79·1	74·1	Dry.
11	,, 12.30 P.M.	197·4	184·8	177·6	152 4	145·8	25·2	14·2	93·5	96·1	95·7	78·8	73·9	Dry.

* This includes the small amount of power required for the excitation of the dynamo field.

Fig. 2 shows the relative efficiencies. They are all remarkably good, but, unfortunately, no readings are given for loads below about 78 H.P. It is a point of no little importance, as well as of engineering interest, to know the small load efficiencies of such dynamos and transformers. We hope that this ommission will be supplied at an early date. It is worthy of note, that since the line efficiency decreases while the dynamo and transformer efficiencies increase with the increment of load, there is a tendency to make the net conversion constant at about 75 per cent. through a considerable range of output.

LEGAL.

The Medical Battery Company v. Jeffery.

IMPORTANT JUDGMENT.

ON Tuesday, at the Bloomsbury County Court, before his Honour Judge Bacon, the claim and counter-claim in the above-named action were heard.

Mr. De Witt (barrister-at-law) appeared for the company, and Mr. Lickfold (Messrs. Lewis and Lewis) appeared for the defendant.

The claim was £3 5s., balance of £5 5s., the price of an electric belt (Harness's patent) supplied by the plaintiff company to the defendant; and the defendant, by way of counter-claim, sought to have an I.O.U. for £3 5s. delivered up to him, and the sum of £2 cash returned to him on the two following grounds:—First, That he was induced to buy the electric belt through misrepresentation; and secondly, that there was no good consideration for the contract into which he had entered with the plaintiff company.

Mr. DE WITT said the plaintiff company carried on business at 52, Oxford Street, and were very well known, and had acquired a high reputation through their sales of electrical appliances for the cure of diseases. His Honour was probably aware of Harness's patents for electric belts and similar appliances. The plaintiffs had a branch establishment where they treated such matters as sprains, injuries to the joints, hernia and ruptures. On May 9th last the defendant, who was a bank clerk, came to the plaintiff's place and said he thought he was suffering from a sprain. The receiving officer of the establishment at once introduced him to Mr. Simmonds, an expert in these matters in the employ of the plaintiffs. Mr. Jeffery said he had a sprain, and was afraid that it might turn to rupture. Mr. Simmonds examined him, and told him it was desirable that he should wear one of Harness's electric belts with a suspender, in order to obviate what might develop into rupture. The defendant asked the price of the belt, and was told £5 5s. The defendant said he could not afford £5 5s., and Simmonds asked, "What can you pay?" The defendant said he had £2, and would pay the balance presently. Simmonds agreed to take the £2, and an I.O.U. for the £3 5s. balance. The defendant agreed to this, and took away the belt. Nothing more was heard until early in June, when the plaintiff company received a letter from the defendant complaining of the belt, but the plaintiff company could not find the letter.

Mr. LICKFOLD said he was able to produce a copy which he would read. The defendant stated, that after wearing the electric belt for some time, sores were brought out on his body. The belt only aggravated the complaint. He had consulted a medical man, and was ordered to leave it off at once, as such an article was in no way fitted for rupture. He demanded the return of his £2, and I.O.U. for £3 5s., and threatened legal proceedings in default. In reply, the plaintiff company wrote, offering to exchange the belt if it did not fit. It was their custom to supply a good-fitting for an ill-fitting belt free of charge. On June 18th the defendant wrote saying there could be no ambiguity about his former letter, and said that unless he received his £2 back, and his I.O.U. for £3 5s. was returned, he should instruct Messrs. Lewis and Lewis to proceed against them. The defendants replied, threatening legal proceedings to recover balance of account, but confirming their previous offer to exchange the belt. On the 27th, Messrs. Lewis and Lewis wrote to the plaintiff company, and in reply received a letter from the solicitors to the plaintiff company to the effect that proceedings had already been taken against the defendant. The defendant then filed his counter-claim.

Mr. DE WITT, continuing, said the correspondence showed the position of the parties. To resume his narrative: the defendant kept the belt for one month, and when asked to pay the balance of the purchase money, refused, saying he was suffering from rupture. He did not know if his learned friend (Mr. Lickfold) relied on breach of warranty, or on misrepresentation. If on breach of warranty, then Mr. Simmonds would go into the box and say he never warranted that the belt would cure the defendant.

Mr. LICKFOLD: I shall not say anything so absurd as that anybody warranted that the belt would cure anything.

HIS HONOUR: The counter-claim is for misrepresentation.

Mr. DE WITT: And what misrepresentation?

Mr. LICKFOLD: The defendant called and asked to see a properly qualified man.

Mr. DE WITT: I shall call Mr. Simmonds, who will tell you that in cases of hernia and rupture he is a qualified man. In cases of rupture he is a specialist, and has had, since his connection with the plaintiff company, no less than 16,900 cases of rupture pass through his hands. In that respect he is qualified. He never said he was a qualified medical man. If the defendant had required to see a medical man, he might have seen one of the two gentlemen always on the premises. Mr. Simmonds will tell the Court that on May 9th, the defendent had not a rupture, but showed symptoms of what might develop into rupture, and, therefore, it was necessary that he should have the internal pressure relieved by external support. The false representation set up here by the counter-claim is, that Mr. Simmonds told the defendant he had not a rupture, and it was not until a month afterwards that the defendant learned he was ruptured. Now, a rupture may happen in a very few days.

HIS HONOUR: Yes, and sometimes in a very few minutes.

Mr. DE WITT: If the defendant can establish misrepresentation, there is an end of the case. But there is no misrepresentation in saying that Mr. Simmonds is a "qualified" man, and no misrepresentation in saying that on May 9th the defendant was not actually suffering from rupture.

The following evidence was then taken:—

Mr. FREDERICK THOMAS SIMMONDS, examined by Mr. De Witt: I have been in the employ of the plaintiff company for nearly seven years. I have had great experience in fitting trusses and dealing with hernia and strains. During that time 16,900 cases have passed through my hands.

HIS HONOUR: How do you arrive at that estimate?

WITNESS: I have taken the middle six months as an average, and multiplied by 13.

Examination continued: The defendant came to our establishment on May 9th, and saw one of the receiving officers. He was shown to my consulting room. He said he had a sprain which he thought

might develop into rupture. I examined him, and said the hernia was incomplete.

HIS HONOUR: Then he was ruptured really?

WITNESS: No, not absolutely. The internal ring was disturbed, but not the external.

Examination continued: I thought there was a fear that that might happen. I recommended this electric belt in order to decrease the pressure and to give a tonic to the muscles.

HIS HONOUR: Why did you not give him a truss?

Witness: He did not require one. My experience is that the wearing of a truss when not necessary is injurious.

What would be the effect of wearing the belt?—It would strengthen the walls of the abdomen.

Would not the wearing of a truss do the same thing?—No; certainly not.

Examination continued: The defendant did not take up his I.O.U. If he had come to us we would have changed the belt.

The defendant says the wearing of the belt was attended with painful consequences, could you have alleviated them?—Yes.

How?—That depends on what the painful consequences were.

When you fitted the belt as you fitted it, would that be attended by painful consequences?—Hardly ever.

Would the wearing of it hurt him?—Certainly not.

When the defendant was consulting you what representations did you make to him?—Nothing particular. He said he was suffering from strain. I told him if he wore the belt for a certain time the injury would probably be removed as it had been in thousands of cases.

What did you say about your qualifications?—Nothing, he never asked me any question.

Did you say to him that you were a "qualified" man?—No, certainly not.

Did you say you believed you could relieve him of the pain from which he was suffering?—Certainly.

Was it unlikely that a rupture would develop by the 9th June, if he did not wear a belt?—Not at all.

Cross-examined by Mr. LICKFOLD: I have been employed by the plaintiff company for nearly seven years. I began treating hernia after I had been with them for about three months.

What were you before you were employed at Harness's?—I was engaged in commercial pursuits.

Have you any qualification for treating hernia?—I have studied it all my life; ever since I was nine years of age.

What was your "commercial pursuit" before you were employed by the plaintiffs?—I was a salesman in the West End of London.

What, in the drapery line?—No, in Oriental furniture.

You do not acquire much knowledge of the treatment of hernia in selling Oriental furniture?—No.

And yet after being in the plaintiff's employ for three months you developed into this consulting person?—Yes.

You thought you had sufficient knowledge?—Yes, I had assistance from others. I am now one of the consulting officers. There are two qualified medical men on the premises daily from 10 until 6. I do not think it absolutely necessary to consult them in cases of hernia.

Is electricity a good thing for hernia?—Yes, in some cases. In the first, or incipient form of hernia, electricity would be a good thing.

HIS HONOUR: What would be its effect?—It would act as a tonic to the muscles—to the weak parts.

Cross-examination continued: Hernia is a bursting of the internal coating of the stomach?—Not of the stomach, the abdomen.

And the bowel protrudes?—Sometimes. It must protrude to form a hernia.

Was there this protrusion when you saw the defendant?—There was a protrusion through the internal ring.

What would be the effect of electricity?—I cannot say, but the belt would give support.

Would the electricity heal the hernia?—No.

Would not the effect of wearing this belt be to press downwards, and so aggravate the symptoms?—No, not a properly shaped belt. There would be support, and the pressure would be upwards.

How many belts did you fit on the defendant?—Only one.

What skill did you show, then, in your treatment of the defendant?—I placed the defendant in a recumbent position, examined the whole of the canal, and fitted a belt on him adapted to his case.

Why did you not send for one of the medical attendants?—Because in matters relating to hernia my practice is far beyond theirs.

And you do not think it necessary to consult them?—Not except in a very complicated and abstruse case—and then they generally leave it to me.

If a person came to your place and said he wanted to consult a medical man?—He would be sent to a medical man.

If he said he wanted to consult some one on hernia?—He would be sent to me.

This belt [the belt sold to and worn by the defendant] weighs between 2 and 3 lbs. Is that a proper belt for hernia?—Yes, for incipient hernia.

How many of these have you in stock?—Between 500 and 600.

Is there any electricity in this?—Yes.

And the patient did not require more electricity than he would get out of this belt?—He would not require an electric battery.

Do you mean to pledge your oath that there is any electrical current here?—I have no knowledge of electricity.

Then why did you sell an electric belt and charge £5 5s. for it?—I have not a large knowledge of electricity, but I have a sufficient knowledge of its physiological effects to know that it would be useful.

Do you pledge your oath that the patient would get a serviceable amount of electricity from this belt?—Yes, certainly. The moisture of the body would complete the circuit.

Did not the defendant, when he called on you, ask for a truss?—No.

How much would a truss cost?—From 2s. 6d. to 12s. 6d.

If you merely intended to support the parts, you could get as much support from a plain belt as from this belt?—Certainly.

Then why did you sell him this?—He wanted a tonic to the local parts.

And so you thought you would give him this 6d. affair?—Yes. I did not give the defendant his bill, it was brought to him.

What is the intrinsic value of this thing?—I do not know.

About 15s.?—I have no idea. I have nothing to do with the cost of the goods.

You are above that sort of thing?—A little above it.

Re-examined: These belts are patented by Mr. Harness?—Yes. Harness has a large number of patents. I am not an electrical expert, and I do not know the mode in which the electrical current passes.

This was the plaintiff's case.

Mr. LICKFOLD, addressing the Court, said, the defendant was a cashier in the Union Bank, and having, as he feared ruptured himself, his attention was attracted to an advertisement of the Electropathic and Zander Institute, 52, Oxford Street, where it was stated medical advice was given gratis. He asked to see a medical man. He saw Mr. Simmonds and told him he was suffering from rupture. Mr. Simmonds examined him, and told him he was not so suffering, and added: "You must have one of our belts and that will set you right." The defendant was fitted, and took a belt costing £5 5s. Instead of doing good, the belt chafed the skin and caused an eruption, and the illness was so aggravated that the defendant consulted a medical man, Dr. Rowntree. After going through the facts, Mr. Lickfold said he should produce evidence to prove that these so-called electric belts were nothing else than fraudulent impositions. People were inveigled into this trap, and belts, which were absolutely worthless, were palmed on them, and they were ashamed to proclaim their folly by prosecuting the promoters of these impostures. But it was now time that it should be put a stop to. The learned gentleman submitted that there had been misrepresentation in this case, because Mr. Simmonds was not a qualified man, and because he misled the defendant by telling him that he was not suffering from hernia when he was so suffering. Then the defendant was entitled to have his money and I.O.U. returned to him as he had not received any good and proper consideration for his money.

The defendant, Mr. D. Jeffery, in examination-in-chief, said in consequence of what I read in an advertisement, I called at Harness's place, 52, Oxford Street. I saw a porter and said I wanted to see a qualified gentleman to inform me if I was ruptured or not. I was introduced to Mr. Simmonds. I told him I feared I was ruptured and wanted a truss. He examined me and said I was not suffering from hernia, and if I used one of Harness's belts I should derive benefit from it. He said he would recommend me an electric belt, and I should soon be all right. He fitted one on me. I dressed. Someone else presented me with a bill for £5 5s. I only had £2 with me, and the cashier said my I.O.U. for £3 5s. balance would do. I was very pleased at being told I was not ruptured. I wore the belt for some time, and it gave me great pain. There was a downward pressure, and a lump formed in my groin—an external sore also formed. When I took off the belt I felt relief. I consulted Dr. Rowntree. I left off the belt entirely and wore a truss, which cost 12s. 6d. I am much better now. The doctor told me I was ruptured, and had been so for some time.

Cross-examined by Mr. DE WITT: I have been a bank clerk for 29 years. I told Mr. Simmonds I feared I was ruptured. He examined me carefully, I believe. I do not think he wilfully intended to do me any mischief. I saw Dr. Rowntree on May 23rd. Between May 9th, when I called at the plaintiff's establishment, and May 23rd, when I saw the doctor, I had been attending to my business. I wore the belt for more than a week. I got so bad, that when I moved I was in excruciating pain. I did not ask the price of the belt before it was fitted on, and had I known it was £5 5s. I would not have purchased it.

What is the false representation you complain of?—That Simmonds told me I was not ruptured.

You complain that you were induced to part with £2 by a false representation. What was the false representation?—I went for a truss. Simmonds assured me that I did not want a truss, and that I was not ruptured.

Re-examined: I got worse whilst wearing the belt.

Mr. WILLIAM GEORGE ROWNTREE, L.R.C.P., examined, said on May 23rd Mr. Jeffery called on me at my house. I examined him, and found that he was suffering from rupture. There was no doubt about the nature of his suffering. I have examined the belt, and I say if it was fitted tight on a patient suffering from rupture it would aggravate the complaint. I have heard the defendant's evidence as to the swelling in the groin, and I think that that swelling had existed for some time previous to my seeing him.

Would the belt produce that swelling?—Not unless there was previous hernia.

Would this belt be of any use to the defendant?—Not of the slightest use. I recommended a truss, and the patient is getting better.

Cross-examined by Mr. DE WITT: Rupture may come on in a few minutes, but there are generally previous symptoms well known to medical men. I undertake to say that the defendant was suffering from rupture on May 9th. I believe the rupture was of one month's duration at least—and from the symptoms which the defendant described to me, it might have been of three months' duration.

Mr. TOM ERNEST GATEHOUSE, M.I.E.E., examined by Mr. Lickfold, said, I am an electrical and consulting engineer of 22 years' standing.

Have you examined this belt [produced and handed to witness]?—Yes.

And what do you say of its electrical powers?—I say that it has none, and that it is utterly useless.

Why do you say so?—Because I have tested it.

There is something in it—some zinc and copper—and why do you say it is useless as an electrical appliance?—Because as the belt stands it cannot generate any electricity at all.

HIS HONOUR: You have heard the witness (Mr. Simmonds) say that the moisture of the body, acting on these bits of zinc and copper, would complete the circuit. Have you tried it in this way?

WITNESS: Yes. The moisture of the body is supposed to act chemically on these metals. Your Honour is acquainted with the old schoolboy experiment of putting a piece of zinc under, and a penny above the tongue, and on bringing the two metals in contact, little flashes of light appear before the eyes of people with highly sensitive nerves.

HIS HONOUR: I did not know about the light. I thought you could only taste.

WITNESS continuing: The moisture of the body would be sufficient to set up a current between two dissimilar metals, but you must have a complete circuit. If I place one-half of this belt on my stomach, and the other half on my back, I have the elements for a galvanic battery, but there is no completion of the electrical circuit.

HIS HONOUR: The witness says the circuit is completed by the action of the moisture.

WITNESS: That is the internal, and not the external, circuit.

HIS HONOUR: Why would not a body touched back and front and all around complete a circuit?

WITNESS: As this belt was worn it never produced a trace of electricity. This morning I made an experiment with this belt, so as to produce a small quantity of electricity. I took salt water, and moistened the two parts, and then I connected the copper and zinc with a galvanometer, and so I got a slight deflection of the needle of about 14 degrees. I then put the belt on my legs, and on my arms, and the deflection was not in the slightest degree altered. That shows that when these belts are worn by any patient no electricity passes through the body in any way whatever, but only along the webbing of the belt and over the skin surface. Electrically these things are useless.

MR. LICKFOLD: Then you say this belt electrically is absolutely a useless article?

WITNESS: Yes.

Cross-examined by MR. DE WITT: Zinc and copper are used in generating electricity.

Do you say that this belt would produce no current at all?—Not as the defendant wore it. The circuit was not completed. I saturated this belt with salt water and then I got a small electrical current. I say there is a current if properly connected up, but the current will not go through the body—it is the webbing and skin and not the body which forms the internal circuit.

This concluded the evidence.

MR. DE WITT contended that though there might have been an error in judgment on the part of Mr. Simmonds, there had been no wilful misrepresentation—such as according to the ruling in the case of Peek *v.* Derry, would entitle the defendant to have his contract rescinded and his money returned. He also submitted that there had been no failure on the plaintiffs' part to give the defendant consideration for his money.

HIS HONOUR, in giving judgment, said: In this case the plaintiff sues for the balance of the purchase money of an electrical appliance, and the defendant by his counter-claim says I want to get back the money which I paid on account, either on the ground that I bought it on the misrepresentations made to me by your agents, or on the ground of a failure of consideration. The defendant has been taken in in the sense that he has been persuaded to buy something utterly useless. It is not every such case which will entitle the purchaser to avoid his purchase and have back the purchase money, but there are cases in which the purchaser is entitled to avoid his contract. After referring to the case of Peek and Derry, his Honour continued: I think it is clear, on the evidence, that the defendant went to the plaintiff's establishment and asked to see a qualified doctor. That was uncontradicted. The defendant has shown that the gentleman whom he saw (the gentleman who calls himself an "expert;" a gentleman without any medical education, or education in this matter, except having studied the best works on the subject since he was nine years of age), and when he asked for a truss, recommended him something which he said was better. The defendant has shown that this gentleman told him he was not suffering from rupture, but only from the beginning of rupture. I have no doubt from the evidence Mr. Simmonds said to the defendant: "I am happy to tell you you are not ruptured." But that was not the fact, the defendant was ruptured, as I cannot help believing from the evidence of Dr. Rowntree, who says: "from my observation, and from the symptoms described to me by the defendant, I am satisfied that the rupture had existed three months before I saw him on May 23rd." Then was the thing which the defendant received the thing which he asked for? I will not enter into the merits of an electrical appliance which I do not understand. Mr. Gatehouse's evidence as to the electrical volume may be right or wrong—I do not know; but this (this belt) is the thing put on the man when he was ruptured, and the man was persuaded to buy it upon the representation that he was not ruptured. He went for a truss. He was told, "You do not want a truss." This is a representation made by a man who had not taken the trouble to qualify himself, and who ought not to have made any representation at all. That was the representation which led to the contract, a contract without any good of any sort to the defendant, and it must be avoided. There must be judgment for the defendant on his counter-claim, and his £2 must be returned to him.

MR. LICKFOLD applied for costs on the higher scale.

HIS HONOUR refused the application. Judgment accordingly.

ELECTROPATHIC BELTS.

THE prestige (save the mark) of the so-called electric belts supplied by the Medical Battery Company, received a severe blow in the Bloomsbury County Court on Tuesday last. The action, which was the means of completely exposing one of the grossest cases of misrepresentation of the present day, is reported at some length in our other columns, and is of special interest to electricians, because the evidence of an electrical expert was, for the first time, we believe, in the history of these so-called electro-medical appliances, added to other overwhelming testimony as to their worthless nature.

The defendant in the action was advised to submit the belt to Mr. T. E. Gatehouse, who reported upon it. It consisted of the ordinary webbing, on one half of which were fixed 12 thin zinc stamped discs, about 1½ inches in diameter, and on the other half 12 copper discs, similar in shape and size, with their surfaces apparently tinned. The discs on either portion were connected up together, in two sets of six, by flexible metallic conductors, so that one half of the belt might be said to contain two zinc, and the other two copper, electrodes. On the external portion of the belt there was a small metal tube or socket in connection with each electrode, evidently with a view of applying electrical energy from an external source; and on the front half of the belt was a suspender with metallic webbing electrodes, connected by India-rubber covered flexible conductors, one to each set of zincs, but as this ornament was superfluous, so far as the patient was concerned, it is unnecessary to allude to it again. It was quite impossible for this belt to generate any current as worn upon the body, for the external circuit was not completed by the connecting up of the zinc and copper poles, nor were any means indicated to the defendant of doing so for himself.

Assume, for the sake of argument, that one of these belts is properly connected up, and that the exudations of the body act upon the metals so as to produce by chemical action an insignificant amount of electrical energy. Does the current so produced pass through the body, and is it of any use medically? To both questions we reply, practically, No!

Under the best conditions of producing galvanic currents, such a combination as zinc and copper in a saline solution could not give a higher E.M.F. than 0·8 volt, and as embodied in an electropathic belt of this type the voltage is probably considerably less than half the value above given, owing to polarisation and other causes. In the best medical practice (and with this we wish to couple the names of Dr. A. de Watteville, Dr. Arthur Harries, Dr. Inglis Parsons, Dr. Lewis Jones, and Mr. Newman Lawrence, whose kind assistance at various times we cordially acknowledge), applying what is termed constant current electricity from external sources, it is found that any current below 5 to 10 milliampères is useless for the majority of cases, but in instances where the head forms part of the circuit, so small a current as 1 to 2 milliampères is sometimes employed.

The E.M.F. required to develop 10 milliampères when the average resistance of the human body is in the circuit, is about 15 volts, so it can readily be seen that the current generated by an electropathic belt is but a mere fraction of 1 milliampère. It must be noted, moreover, that the resistance of the body does not remain the same with different E.M.Fs. It is a function of the cataphonic action of the current, hence it diminishes with every increase of E.M.F. of the battery and *vice versâ*. Supposing a battery of 10 volts gives a current of 5 milliampères through a given portion of the body, a cell of 1 volt may give rise to but a minute fraction of a milliampère. Further, the people to whom the same kind of belt is supplied probably vary very much, both in skin properties and tendency to perspire. For instance, a diabetic subject would have a perfectly dry skin. We have always contended that "belts" such as that which was the bone of contention on Tuesday, give practically no current, even under the best conditions, and that most, if not all, of the insignificant quantity of electricity generated by such appliances flows along the *webbing of the belt itself* and partly, perhaps, over the *moist surface of the skin*. We are not alone in this opinion, but we do not know that any experiment, previous to what seems to be a conclusive one performed by Mr. Gatehouse just before the commencement of the action

had ever been made to settle this question. The belt was laid flat upon a bench and moistened with a weak solution of salt and water; a very sensitive galvanometer of the P.O. pattern was then connected with the copper and zinc discs and a deflection of 14 divisions obtained. Now if the belt, still connected with the galvanometer, were taken and the zinc discs placed upon one leg, the coppers on the other, that portion of the body forms a shunt to the webbing of the belt, and assuming that the current could overcome the skin resistance, the total resistance in circuit would have been much diminished and the current correspondingly increased, but no such result was obtained; the needle remained stationary. So it was when the hands and arms formed part of the circuit, and it was only by deliberately wetting the legs and hands that any higher deflection was obtained, and that only about 4 degrees. These conditions were verified in the case of another gentleman who obligingly placed himself at Mr. Gatehouse's disposal. The sensitiveness of the galvanometer was such that 0·8 volt would give the 14 divisions (which represented a current of ·026 milliampère) through 30,000 ohms resistance.

It is perfectly evident therefore from this experiment that the current which was flowing through the webbing of the belt itself is not increased by contact of the belt with the body when it (the latter) is in its normal state, and not wetted by the external application of liquid.

This will be very satisfactory information to the medical profession, for doctors can now state positively that the current generated by these appliances does not overcome the skin resistance, and cannot therefore possibly influence the body.

If the much to be pitied individuals of both sexes who so readily fall into the snare set by the president of the *British Association of Medical Electricians*, and of the Medical Battery Company, would only reason with themselves, a few minutes reflection ought to convince the most foolish that the idea of a poor debilitated body generating the electricity for alleviating its own suffering is most preposterous. Indeed the stepping stone from hallucinations of this kind to the borderland of a profound belief in perpetual motion can be but a narrow one.

Their supposed curative results are fully accounted for by a kind of "hypnotic suggestion" akin to the well-known effects of bread pills on sensitive organisms.

But having satisfactorily disposed of the electrical pretensions of these patented articles, where can words be found sufficiently strong to condemn the practices carried on in the Oxford Street mansion in the treatment of rupture?

That it should be possible in these days of enlightenment, and in the midst of the largest city in the world, for 16,900 cases of a serious malady to have been treated by a man having such qualifications for the task as the consulting officer of the Medical Battery Company proved himself in the witness box to possess, is beyond the comprehension of any reasonable being; and if ever there was a matter demanding the immediate attention of the Public Prosecutor, the revelations made at the Bloomsbury County Court point to it.

If the treatment, by an unqualified man, of incurable disorders which require careful and skilful medical attention, is not actionable at law, the sooner some bill is passed through Parliament to make it so, the better for suffering humanity.

It is bad enough that the male sex should submit to be "examined" by these so-called "experts," but to think that gentle, refined, and highly sensitive women should be contaminated by the mere touch of such "consulting officers," is utterly abhorrent to the feelings of anybody possessed of a trace of morality or a scrap of manliness.

We trust that the report of this disgraceful case may be disseminated far and wide, for it will do much to enlighten the public as to the real status of Mr. C. B. Harness, and the manner in which those who read, and are misled by his advertisements, are "examined," if by an unlucky chance they are led to consult the consulting officers of the concern over which he presides. No wonder that he can spend yearly in advertisements a sum which most people would consider a princely fortune, if 16,900 cases are treated at five guineas a time—probably more in numerous instances—in between six and seven years.

Weight may, perhaps, be still further added to our comments, if we state that Mr. W. H. Preece, F.R.S., chief electrician to the Post Office, to whom, at his request, Mr. Gatehouse showed the belt, has sent him a letter to the effect that so far as he could see from an examination of the appliance, and from the results of the tests, it would be quite impossible for the belt to generate a current of electricity through the body.

NOTES.

The Popp Company in Paris.—The Popp Company has just asked the Municipal Council to authorise the establishment of electric canalisations in the Rue Molière and the Rue du Sentier. These streets are in the sector which was granted to the Popp Company in 1888. According to the conditions laid down in the specification, all the streets in the sector are to be canalised in succession.

Telephony in France.—Paris will shortly be in telephonic communication with all the principal towns in France. There are already systems between Paris and Bordeaux, Paris and Lille, Paris and Lyons, and Paris and Marseilles, and the installations are continually being extended. At the beginning of this month a line was opened between Paris and Beauvais.

Electric Lighting at Bath.—Some time since, complaints were rife as to the electric light at Bath, but at a meeting of the Council last week, the Inspector reported that since March 11th only three lamps had been reported out, and, as a whole, the lamps had burned with great steadiness. Out of the 84 lights, 43 had been provided with the Pearline globes, which the Chairman of the Committee considered to be a great improvement.

Provisional Orders.—The Holborn Board of Works have received notice from the County of London (North) Electric Lighting Company of intention to apply for a provisional order to supply the electric light to the district of Holborn. The Islington Electric Supply Company have also sent in a similar notice.

The County of London Electric Lighting Company having intimated to the Poplar District Board their intention of applying for a provisional order for Poplar, the Works Committee of the Board are to consider whether it would not be to the advantage of the district if the board were itself to make application.

A New Method for Determining Specific Inductive Capacity of Dielectrics.—There is a paper in the June number of the *Philosophical Magazine* that ought not to be missed: it is by Messrs. F. T. Trouton and W. E. Lilly, and develops a new method of determining the specific inductive capacity of dielectrics. One of the advantages in this method is the possible avoidance of all doubtful approximate calculations, and in this respect it is analogous to a method advocated by Lord Kelvin for determining the magnetic permeability of iron. When suitably modified, it appears also well adapted for such determinations as the specific inductive capacity of crystals in different directions. The paper is accompanied by illustrations of the apparatus employed.

The International Society of Electricians of Paris.—The sitting of the Society took place on July 6th, M. J. Carpentier being president. Dr. J. Larah presented a communication relating to the therapeutic effects of alternating currents, and showed a series of apparatus which he employed in order to utilise them. M. H. Pellat then gave a description of an apparatus for marking the progress of trains and of a system of signals for the avoidance of collisions. The apparatus in question was a chemical register showing the progress of the trains by means of marks formed on the paper by the decomposition of a diluted solution of iodide of potassium. This apparatus was sharply criticised by several of the members present, and especially by M Chaperon, the chief director of the railways of Paris, Lyons and the Mediterranean. M. E. Hospitalier presented several apparatus for heating by electricity, amongst others, apparatus for boiling water, ironing and soldering apparatus, lighters, &c. This last discussion greatly interested the audience.

A New Electrical Journal.—The new monthly journal to be published in Chicago, to which we recently referred, is to be known as *The Popular Electrician*.

London-Paris Telephone.—A call office was opened in connection with the London-Paris Telephone at the West Strand office, Charing Cross, on Monday last.

Dover Electric Lighting.—The difficulties with respect to the installation of the electric light in Dover, so far as the agreements are concerned, are now overcome, says the *Dover Standard*. The company is to be known as the "Dover and Canterbury Electric Supply Company," but two accounts are to be kept, and the chief office is to be at Dover. It is very probable now that in the course of twelve months electric lighting will have become an accomplished fact in Dover.

Hammersmith Electric Lighting.—The County of London Electric Lighting Company and the Putney and Hammersmith Electric Lighting Company have each presented to the Hammersmith Vestry notices of intention to apply for a provisional order for the parish. The vestry, however, think that it will be to the advantage of the district if the order is taken up by the authority, and a special meeting of the vestry will shortly be held to fully consider the matter.

Yarmouth Electric Lighting.—At a meeting of the Town Council held last week, the Electric Lighting Committee reported having issued conditions and instructions to persons tendering for fitting up an electric lighting installation, tenders to be delivered on July 28th next. The committee decided to ask Mr. Preece what fee he would require to advise them with respect to the adoption of the best scheme for electric lighting, after the tenders had been opened. The report was adopted.

The Azores Cable.—The *Financial Times* for last Saturday stated that a Bill had been laid before the French Parliament for the concession of a submarine cable from Brest to Lisbon, the Azores, and Hayti, in connection with the existing French lines between the West Indies and South America. The French Government guarantees for 25 years a revenue of 2,300,000 f., exclusive of working expenses. The cable must be made in France, be laid down by a French steamer with a French crew, and the directors of the company must be French.

Attempted Murder and Suicide at Silvertown.—An inquest was held on Monday last upon Henry Read, a labourer, who committed suicide after attempting to murder Mr. Christian Gray, one of the managers at the India-Rubber, Gutta-Percha, and Telegraph Company's Works at Silvertown, on Friday last. Evidence given showed that the deceased was of unsound mind, and a verdict to that effect was returned. It appears that Read followed Mr. Gray and stabbed him in the throat, inflicting a very serious wound. We are glad to hear that Mr. Gray is progressing favourably, and we sincerely congratulate him upon his fortunate escape.

The Institution of Electrical Engineers.—The Council of the Institution recently brought to the notice of the First Lord of the Treasury the strong claims which, in their opinion, Mr. Jacob Brett has on the Government for some further pecuniary aid in his old age, and we are glad to hear that their representation has resulted in a grant of £200 being made to him from the "Queen's Bounty" on the recommendation of Mr. Balfour. In Part 95 of the Proceedings of the Institution, pp. 510—515, there is an admirable account by Mr. Latimer Clark, of the important part taken by Mr. Brett and his brother, Mr. J. W. Brett, in the introduction of telegraphy, both land and submarine. In fact, to those gentlemen seems undoubtedly to belong the distinction of being the real pioneers of ocean telegraphy. It is a somewhat curious, and in some sense a melancholy coincidence that this second mark of recognition by the British Government of Mr. Brett's services should have been conferred upon him within a few days of the lamentable death of Mr. Cyrus Field to whose indomitable energy the practical realisation of the Messrs. Brett's scheme for the establishment of an Atlantic telegraph was undoubtedly greatly due.

The Electric Light in Germany.—The question as to the adoption of the electric light on the North Baltic Canal in Germany is at present under consideration.

Electrical Tramways in Germany.—A company was formed in Breslau last month with a capital of £157,500 to be known as the Breslau Electric Street Railway Company.

Electric Light at Edinburgh.—At the Edinburgh Dean of Guild Court last week, permission was granted to the Caledonian Railway Company to erect electric light appliances at their Princes Street station, Edinburgh.

Electric Light in St. Pancras.—There is to be a further extension of the electric light in St. Pancras, the Electricity Committee having resolved to light Hampstead Road and High Street, Camden Town (to Park Street), and a portion of Camden Road. The cost of this extension will be £4,700.

Windsor Electric Lighting.—The Electric Light Committee of the Windsor Town Council recommend that consent be given to the electric light company to carry out the lighting of a portion of the town instead of the whole district specified in their provisional order. The report has been referred back for further particulars.

Preston and Electric Lighting.—The following resolution was passed at a recent meeting of the Preston Local Board:—"That the clerk write to the British Insulated Wire Company to ascertain the terms on which they would light the streets of the town by electricity, and that they be asked to furnish a report showing how they would do it."

Electrical Communication between Lighthouses.—The Royal Commission upon electrical communication between lighthouses and lightships and the shore held its first regular meeting on Tuesday, Lord Balfour of Burleigh presiding. Sir George Nares, Sir Leopold M'Clintock, Mr. F. Bedwell, hydrographer to the Telegraph Construction and Maintenance Company, and Mr. Scott, secretary of the Meteorological Council, gave evidence. The Committee considered the cases of the various lightships and light vessels in the United Kingdom.

Aberdeen and Electric Lighting.—The Gas Committee of the Aberdeen Town Council have purchased, for £1,900, the Bon-Accord Mills, Cotton Street. It is understood that the intention is to utilise the building—which is in close proximity to the gas works—in connection with the supply of electric light to the city, whenever the Corporation take practical steps in that direction.

Electric Light Explosion at Bournemouth.—On Saturday evening last there was a slight explosion in one of the boxes of the Electric Light Company, fixed in the square, which contained the fuses for controlling the mains leading to Exeter Road, &c. Upon making an examination, it was found that the damage was unimportant, two of the fuses having merely shifted from their original position, evidently through the action of some gas which got into the fuse box, and mixing with the air, made it explosive. It is conjectured that some one passing in the square just at this critical time must have thrown down a lighted match, which ignited the gas, and caused the explosion.

Electric Lighting at St. Helen's.—The scheme for providing electric lighting for St. Helen's Town Hall and Municipal Offices was practically completed last Monday, when a prolonged trial of the new lighting arrangements gave every satisfaction. The whole of the plant has been supplied by Messrs. Bumsted and Chandler, of Cannock Chase, Hednesford, and has been erected by their chief engineer, Mr. Stephen H. Terry, M.I.C.E. The wiring and fitting arrangements have been carried out by Messss. J. D. F. Andrews & Co., of London, under the direction of their resident engineer, Mr. John D. Bailey, and have been superintended for their consulting engineer (Mr. Bromley Holmes) by Mr. C. H. Yeaman, engineer of the Prescott Electric Lighting Company. The total expenditure has been about £1,500.

Launceston and Electric Lighting.—The *Financial News* states that the Launceston City Council have adopted a report favouring the lighting of the city with electricity.

Masonic.—At a meeting of the brethren of the Sydney Lodge, No. 829, held at Sidcup, on Tuesday last. Mr. S. B. McClellan, electrical engineer, of 26, Ludgate Hill, E.C., was duly installed worshipful master for the ensuing year.

Another New Ozone Apparatus.—The electrical arrangement of apparatus for producing ozone on a large scale has hitherto, or for the most part, consisted in interposing between two conducting coatings charged with electricity of "opposite sign," one of two dielectric layers, and the layer of gas to be ozonised. According to a method proposed by Messrs. Siemens & Halske, both the electric coatings are situated on the same side of the dielectric layer and separated by a shield of insulating material, while at a small distance from the other side of the dielectric layer is situated an insulated conducting plate. Thus currents will pass from the part of the dielectric layer below the one electric coating, through the narrow space in which the gas to be treated is situated, to the insulated plate, and from this back again through the gas to the part of the dielectric layer beneath the second coating.

Output of Influence Machines.—At a meeting of the French Physical Society on July 1st, M. Abraham gave an account of some experiments on the relation between the output and the speed and charging potential of a simple form of influence machine, which appear to have given very exact results. In the machine used, a rotating glass disc conveys two nearly semi-circular carriers through two hollow field plates of corresponding form, air only intervening. The metallic coatings are silver deposited on glass. A stationary spring is placed within each field plate, so as to touch the carriers until they begin to move from within the field plate. One field-plate, and the spring within it, are connected respectively to the terminals of a galvanic battery, the carriers thus receiving charges in passing this part of the machine. The second field plate and spring are connected together, so that the carriers give up the whole of their charges while within this part. The second field plate is connected through one coil of a differential galvanometer with the first spring, which is also earthed, and the current thus produced is balanced by another current derived through variable resistances directly from the same battery. It was found that the current produced by the machine is proportional to the charging potential, and to the speed of rotation, within $\frac{1}{1000}$th. By comparing the output calculated in electrostatic measure from the dimensions of the machine, with the actual output measured electro-magnetically, the value of the ratio v was shown to lie between 2·98 and $3·01 \times 10^{10}$, uncertainty as to the allowance to be made for the diametral edges of the conductors rendering it impossible to get an exact result.

NEW COMPANIES REGISTERED.

Electrical Company, Limited.—Capital, £15,000 in £5 shares. Objects :—To acquire and take over the business, assets and liabilities of Keys' Electric Company, Limited, with a view thereto to enter into an agreement with that company and its liquidator; and to carry on the business of electrical and mechanical engineers, contractors for the supply of electricity and manufacturers of and dealers in electrical plant and apparatus. Signatories (with one share each): F. Deutsch, Warnford Court, E.C.; F. T. Eggers, 24, Upper Bedford Place, W.C.; V. Melcher, 166, Shaftesbury Avenue, W.C.; E. A. Bartels, 10, Blenheim Gardens, Willesden Green; Alfred A. Rothschild, 37, Cleveland Square; C. Schlesinger, 11, Portland Place, W.; O. Hertz, 56, Belsize Park Gardens, N.W. The number of directors is not to be lesss than two nor more than five, the first being Franz and Felix Deutsch. Remuneration, 10 per cent of the net profits available for dividend. Registered on the 13th inst. by Michael Abrahams, Sons & Co., 8, Old Jewry, E.C. Registered office; 122 and 124, Charing Cross Road, W.C.

Lironi and Bowman, Limited.—Capital, £2,500 in £1 shares. Objects: To acquire and carry on the business of electricians, electrical and mechanical engineers, &c., carried on by V. G. Lironi and J. J. Bowman, at the Bow Electric Works, Arnold Street, Bow; and with a view thereto to enter into two agreements (1) with V. G. Lironi and J. J. Bowman, and (2) with T. W. and A. J. Holington. Signatories (with one share each): V. G. Lironi, Walnut Tree House, Leytonstone; J. J. Bowman, Strathclyde, Bulwer Road, Leytonstone; E. A. Lironi, Walnut Tree House, Leytonstone; T. W. Hollington, 25, Walworth Road, S.E.; A. J. Hollington, Aldgate, E.; J. B. Gisborne, Hope House, Primrose Road, South Woodford; J. S. Morrison, 32, Guildford Street, W.C. The number of the directors is not to be less than two nor more than five, the first being A. J. Hollington, T. W. Hollington, V. G. Lironi, and J. J. Bowman. Qualification, £50. Remuneration, as fixed by the company in general meeting. Registered on the 13th inst. by Fraser and Christian, 4, Finsbury Circus, E.C.

Universal Arc Lamp Syndicate, Limited.—Capital, £3,000 in £1 shares. Objects: To acquire, develop, and turn to account a certain invention of improvements in electric arc lamps for which a patent has been applied, and which is described in the provisional specification, No. 7,095, of 1892; to carry on the business of an electric light and power company; and to carry on the business of electricians, electrical and mechanical engineers, contractors for the supply of electricity and manufacturers of electric lamps and other apparatus. Signatories (with one share each): C. H. Freedman, 66, Berners Street, W.; A. R. Carter, 4, Arthur Street, New Oxford Street, W.; A. H. Vesey, Cadogan Gardens, S.W.; F. Suter, 90, Lady Margaret Road, N.W.; H. Wyman, 66, Berners Street, W.; J. Yelloley, 15, Birdhurst Road, Wandsworth; C. Wyman, 82, Liverton Street, Kentish Town, N.W. The number of directors is not to be less than three nor more than five, the first being C. H. Freedman, F. W. Suter, and A. R. Carter. Registered on the 16th inst. by Valpy, Chaplin & Peckham, 19, Lincoln's Inn Fields, W.C.

Theatre Electrical and Specialities Production Company, Limited.—Capital, £5,000 in £1 shares. Objects: To acquire and take over as a going concern the business carried on by Messrs. Gritton, Madgen and Heald at 28A, Leicester Square, W.; and to carry on the business of theatrical and music hall proprietors, hotel and restaurant keepers, dramatic and musical agents, gas, electrical and mechanical engineers, contractors, &c. Signatories (with 1 share each): F. J. Madgen, 37, Harrington Road, S.W.; W. T. Hemsley, 147, Buckingham Palace Road, S.W.; A. E. Pickering, 33, Lambeth Palace Road; V. Fabris, 18, Rathbone Place, W. (electrician); A. B. Anderson, 38, St. Alban's Road, Watford; S. M. Bouts, 5, Sandbrook Road, Stoke Newington, N.E. Registered, without articles of association, on the 12th inst., by F. H. Heald, 28A, Leicester Square, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electricity Supply Corporation, Limited.—An agreement, made the 9th ult. (filed 21st ult.), between the above-named corporation of the one part, and Messrs. A. and S. Gatti of the other part, states that whereas when the subscription list closed (on the 1st ult.), 4,711 £5 shares and 93 £100 debentures had been subscribed for (a sum insufficient by £110,745 to discharge the indebtedness of the corporation to Messrs. Gatti), it was therefore agreed that the corporation should allot to Messrs. Gatti 15,289 shares of £5 each (numbered 10,001 to 25,289 inclusive) and 353 debentures of £100 each, and that the £110,745 payable in respect of such shares and debentures should be retained by Messrs. Gatti on account of the indebtedness of the corporation to them. Messrs. Gatti also agreed to take up, or cause to be taken up, £25,400 in debentures for the purpose of supplying working capital for the corporation.

Lancashire Electric and Engineering Company, Limited.—The annual return of this company, made up to September 27th, 1889, was filed on April 13th, 1892. The nominal capital of the company is £20,000, in £5 shares.

375 of these have been taken up, and a call of £2 per share made, resulting in the payment of £580, leaving £170 unpaid.

Another annual return, made up to June 21st, 1891, was filed on the same date as the foregoing return, when the same number of shares being taken up, a call of £5 per share had been called and paid.

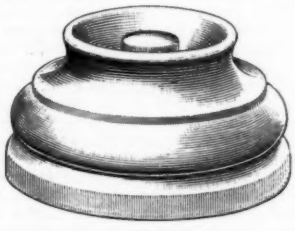
The annual return for 1892, made up to March 15th, was also filed on April 13th, when the same number of shares were taken up as in the other returns. Registered office, 11, Chancery Lane, Bolton.

Reuter's Telegram Company, Limited.—The annual return of this company, made up to the 15th ult., was filed on the 20th ult. The nominal capital of the company is £100,000, divided into 12,500 shares of £8 each; 10,802 shares have been taken up, the full amounts called, and all calls paid. Registered office, 24, Old Jewry, E.C.

R. C. Cutting, Douglass and Company, Limited (lightning conductor manufacturers and electrical engineers).—An agreement made the 13th ult. (filed on the same day) between Archibald Douglass, of Wardrobe Chambers, Queen Victoria Street, E.C., of the one part, and the company of the other part, states that the purchase consideration will be fully satisfied by the allotment to the said Archibald Douglass of 1,979 shares of £5 each, each of which is to be considered as paid up. Registered office, Wardrobe Chambers, Doctor's Commons, London, E.C. (Filed on the 17th ult.)

BUSINESS NOTICES, &c.

Novelties.—Referring to our notice of the Bell pushes manufactured by the General Electric Company in last week's issue, we have received the following letter from the Birmingham Telegraph Factory, Limited:—"In your last issue, we notice a description and illustration of an electric bell-push, for which it is claimed that it is novel, in having the whole of the fittings mounted on a



porcelain base. Will you therefore permit us to mention that we have for the last three years been manufacturing and selling an article, as per illustration, in which the idea of adapting the china base to the bell-push was adopted, and therefore it is rather late in the day to patent it now.—The Birmingham Telegraph Factory, Limited."

The Electric Light in the West End.—The adoption of electric lighting in the West End is still progressing. Since our last report we note that Mr. Ronald Scott, of the Acton Hill Works, W., is fitting up an installation at No. 14, Southampton Street, Strand; Messrs. Spagnoletti & Crookes, of Goldhawk Works, W., are carrying out an installation at Burlington House, Piccadilly; Messrs. Rashleigh Phipps & Dawson, of Berners Street, W., are carrying out an installation at No. 33, Haymarket; Messrs. S. W. Gray & Co., of 69, Commercial Street, E., are carrying out an installation in the premises of Messrs. Herbert & Co., army and navy clothing contractors, Blue Cross Street, W.C. Messrs. Drew & Sons, portmanteau and bag manufacturers, of Piccadilly Circus, are extending their premises, in which the Planet Electrical Engineering Company, of Victoria Street, are fitting up an electric installation. Messrs. Emanuel & Son, of High Street, Marylebone, are fitting up an installation in the premises of Messrs. Stollwerck Brothers, Piccadilly Circus. Messrs. Edmundsons, Limited, of Great George Street, Westminster, are fitting up an installation in the premises of Messrs. Louise & Co., of 210, Regent Street. Messrs. Bergtheil & Young, of Wallbrook, E.C., have just completed an installation in the new establishment of the Imperial Fur Stores, 162, Regent Street. Messrs. E. L. Berry, Harrison & Co. are fitting up an installation in the Lyric Chambers, Whitcomb Street, W.C.

Frederick Nell.—We have received from Mr. Frederick Nell, of 16, Mark Lane, his new catalogue of steam and power pumps, manufactured by the Smith and Vaile Company, who are well known in America for their high-class work. These pumps are well known on the European market, but till now the Smith and Vaile Company have not been represented here. The catalogue is well illustrated, and gives particulars of a number of types of pump, each specially designed and constructed for the requirements and duties for which it is recommended.

Personal.—We are informed that Mr. G. H. Nisbett and Mr. F. H. Jackson have been appointed respectively second and third engineer to the City of London Electric Lighting Company. Mr. Nisbett was formerly with Messrs. Paterson & Cooper, and Mr. Jackson was out-door superintendent to Messrs. Willans & Robinson, and until recently they were both members of the staff of Major-General Webber, late chief engineer to this company, the former being chief assistant and the latter station engineer.

We are pleased to note that Mr. R. Calder has been appointed the London manager of the National Telephone Company, Limited, in succession to Mr. D. Sinclair.

W. T. Glover & Company.—Messrs. W. T. Glover and Company, of Salford, Manchester, have just introduced a new winding machine for winding very fine wires on bobbins with bevelled flanges, similar to spools for sewing cotton and silk. They have long made wire winders for bobbins with parallel flanges, but have introduced this machine with a new differential traverse motion and stop motion to stop the bobbin when the wire breaks, to meet the requirements of those who wish to wind on bobbins with bevelled flanges. They will be glad to show samples of bobbins wound on this machine.

Drake & Gorham.—In addition to the large number of country house installations which Messrs. Drake & Gorham have in hand, they are busily engaged in London wiring work. Among the latter we observe the following:—The London Assurance Corporation, Royal Exchange, with 180 lights, Bank of Egypt, Old Broad Street, Law Union Fire Offices, Chancery Lane, and the Credit Lyonnais, Charing Cross.

Lighting the Surveyors Institution.—An installation of electric light is about to be carried out at the Surveyors Institution under the superintendence of Mr. Morgan Williams, Assoc.M.Inst. C.E., the contractors for the work being the firm of Messrs. Pyke & Harris.

Removal.—To meet the rapid growth of their business as wood wool manufacturers, Messrs. Chapman Co., Limited, of Deptford, have found it necessary to remove to larger premises on the Surrey Canal. The sole addreess in future will be Crown Wharf, Grove Street, Deptford, S.E.

Tenders Wanted—Spain.—The authorities of the Municipality of Alcaniz, in the province of Téruel, Spain, are inviting tenders until the 26th inst. for the public lighting of the town by means of electricity.

Joel & Co.—The electric light, which has been so marked a success in the church of St. Nicholas Cole Abbey, has now been installed at St. Nicholas rectory by the same engineers, Messrs. Joel and Co., of Wilson Street, Finsbury.

King, Mendham & Company.—On Saturday last, the *employés*, numbering between 50 and 60, of Messrs. King, Mendham and Co., electrical engineers and contractors, of Bristol, had their annual outing. On this occasion the party went to Plymouth.

Frederick Smith & Co.—On 16th inst. Messrs. Frederick Smith & Co., of Halifax, reduced their price for high conductivity copper wire ¼d. per lb., making present basis price, 0 to 20, 7d. per lb.

CITY NOTES.

Crompton and Company, Limited.

THE directors' report to be presented next Friday states that the business of the company continues satisfactory, and that the reorganisation and additions to the Chelmsford works have proved a great advantage in increasing the output and reducing the cost of manufacture.

In order the more effectually to separate the accounts for the electric lighting of Chelmsford from the manufacturing and other accounts of the business, the directors have caused to be registered the Chelmsford Electric Lighting Company, Limited, to which company the installation outside the arc works has been transferred. The shares in the new company will, of course, be chiefly held by this company. The private lighting at Chelmsford is increasing very satisfactorily, and in a short time it is anticipated the new company will be working at a profit.

The whole of the preference shares offered to the members in November last having been subscribed, the directors now propose to issue the balance of 4,781 shares at a premium of 10s. per share, and the members are invited to send their applications for the same to the secretary. This will complete the authorised issue of shares, and will provide the working capital necessary for the business, as stated at the meeting last year. The net premiums will be placed to reserve.

The net profits for the year amount to £15,068 16s. 11d., and after providing for the debenture interest and other payments set out in the revenue accounts, and deducting the interim dividends already paid on both the preference and ordinary shares, there remains, with the £127 7s. 5d. brought forward from last year, a balance available for dividend of £7,347 7s. 4d.

The directors propose, after setting aside £750 as a provision for doubtful debts and contingencies, to declare a dividend of 3s. 6d. per share, making 7 per cent. per annum upon the preference shares, and 4s. 6d. per share, making, with the interim dividend, a total of 7 per

cent. per annum upon the ordinary shares, to place a further £1,000 to the reserve fund, and to carry the balance forward.

Mr. C. F. Tufnell retires from the board of directors by rotation, but offers himself for re-election; as do the auditors, Messrs. J. H. Duncan & Co.

The Direct United States Cable Company, Limited.

THE directors' report states that the half-year's revenue, after deducting out payments, amounted to £39,014 14s. 1d., against £37,352 19s. 5d. for the corresponding period of 1891, being a difference of £1,661 14s. 8d. in favour of the half-year under review.

The working and other expenses for the same period, including income tax, but exclusive of cost of repairs of cables, amounted to £19,018 11s. 3d., leaving a balance of £19,996 2s. 10d. as the net profit of the half-year, making, with £4,982 15s. 3d. brought forward from the previous half-year, a total of £24,978 18s. 1d. For the corresponding period of 1891, the working expenses and other payments amounted to £18,112 19s. 8d.

Three quarterly interim dividends of 3s. 6d. each per share amounting to £31,872 15s., have been declared and paid during the financial year, and a final payment of 3s. 6d. per share is now proposed, making, with the three interim dividends, 3½ per cent. for the year, being a total distribution of £42,497. The balance of £3,730 8s. 1d. on the revenue account it is proposed to carry forward.

During the period under review, repairs have had to be made in both sections of the company's cables at a cost of £9,385 6s. 2d., which has been debited to the reserve fund account as heretofore, the balance of which now stands at £254,716 13s. 10d.

The directors have to report with extreme regret the deaths of their esteemed colleagues, Mr. William Ford on May 14th, and Admiral R. C. Mayne on May 29th last. The vacancy on the board, occasioned by Mr. Ford's decease, has been filled up by the election of Mr. James Pender. It is not intended at present to fill up the second vacancy.

The Edison and Swan United Electric Light Company, Limited.

THE annual meeeting of the shareholders in this company was held on Tuesday last at Cannon Street Hotel, Mr. James Staats Forbes presiding.

The SECRETARY (Mr. Gover), having read the notice convening the meeting,

The CHAIRMAN said, as the report had been circulated with the accounts, he presumed they might take it as read, as usual. The report was very short, and he proposed to make very few remarks upon it. He had had occasion before to call attention to the condition of a company like this, where circumstances operating upon its interests made it expedient that the accounts should be stated in a manner rather more general than in some other companies which had a statutory form of accounts. He supposed as the period arrived when the patents were running out that reticence became even more necessary than in the earlier stages, and that was why their accounts were so brief in statement, and were confined to so few elements as compared with those of some other public companies. The essence of the reports was what profit had been made, and how they proposed to divide it. He would remind them of the peculiar position of the company, and that however satisfactory the result as shown upon the particular year might be in the distribution of dividend, it was necessary to bear in mind that there were some considerations causing a depreciation of that dividend. For instance, they proposed to the shareholders to divide such an amount of the profit realised upon the year, as with the provisional dividend paid, in six months amounted to 18 per cent., last year they paid 17 per cent., the year before 15 per cent., and in 1889 their first dividend-paying year they paid 10 per cent. There was nothing so readily excited as the cupidity of mankind, and as their business was being watched with a good deal of interest by a good many outsiders who, when it became an open business, would be ready to launch upon it in competition with them, it would be just as well to bear in mind that for the five years preceding 1889 of the company's existence they paid no dividend at all, and perhaps it might qualify, not their satisfaction, but the aspirations of some other people, to know that notwithstanding they proposed to pay this fresh dividend, really over the whole nine years the aggregate amount divided had only reached the moderate amount of 6½ per cent. It was just as well that that should go forth to the outside world, because they knew there was a disposition upon the part of the consumer, to think himself aggrieved with the company whose supplies he consumes, because it appears to be paying a considerable dividend. As to the accounts themselves, he had better take them through what was called the profit and loss account, or the working account. They would see it was very simple, consisting of only three or four headings. They, of course, began every year with a large stock of lamps and material in anticipation of requirements and manufacture of a current year. That always came in the first column, and the amount of that carried forward from year to year was a matter of some importance in forming an opinion of the position of a company; it might be too large or it might be too small; if too small, the company might be placed at a disadvantage in the event of there being a sudden call for lamps—a sudden growth in the want—or it might be too large and involve the locking up of more than the necessary capital invested in the stock. They would see that on July 1st, 1891, they brought into the account £59,308 worth of stock; that was made up largely of lamps and of platinum and other materials in hand. During the year to keep abreast of the consumption, notwithstanding the possession of so large a stock, they had spent in wages, purchase of materials, &c., £59,001; that was the bare cost of the lamps produced at the factory, the more mechanical part of producing and the material worked up in the manufacture of so many lamps. Then there were the administration expenses, the various heads of departments, the directors of that machinery which presented in a public company what the brains and directing influence represented in a partnership. There was a small amount, but they thought it sufficient, put down for the depreciation of plant. On the other side of the account there was sale of lamps and fittings, and royalty on holders, &c., £166,348, interest £473, and the stock on hand when they emerged from the year, £45,225. Of course, the difference between those two was the balance of profit to be dealt with for the year, which amounted to the respectable sum of £74,810 16s. 7d. What he rather particularly wanted to call their attention to was that that amount was satisfactory, in the sense of having diminished somewhat considerably the amount of their money locked up in stock, and he thought he might say so without at all fearing question upon the other possibility that there was not stock enough on hand to meet any sudden emergency. He thought they might say, to that extent, their position was a little more wholesome than at this time 12 months ago. They had produced that state of things by dealing pretty liberally with elimination from the account of stock which had become more or less *effete*; in fact, they had written it down. Some considerable portion of it, of course, had gone to make up the increased income derived from sales, but some not inconsiderable portion had gone to writing down the value carried forward into the account of this year as the value of stock in hand. He thought they would consider that a safe and prudent thing to do. That large figure of £166,348 was not made up exclusively of the sale of lamps, because for two or three years they had themselves been manufacturing fittings which were an adjunct to lamps. The lamp was a very delightful and wonderful instrument, but it required to be fitted in a great variety of ways, according to the tastes and circumstances of the consumers, and they were proving the necessity of manufacturing fittings. They had secured some very interesting and ingenious patents for fittings, and they were manufacturers and also licensers. They had licensed a great number of respectable firms engaged in that fitting trade; people who were gasfitters had now become electric light fitters, and they (the Edison and Swan Company) gave them the option of manufacturing their own fittings if they chose. From the royalties paid by those different licensees they received a considerable annual sum. As the lamp patent would expire at no very late date, the inventions would afford them, during what might be called a protective period, a very considerable and growing annual profit. Regarding the balance, £74,810, they had already distributed in the course of the year a considerable portion of that in the nature of dividend, and they proposed to apportion the remainder so as to produce this 18 per cent. upon the year, and in order that they might understand that he would refer them to paragraph 2 of the report, which was somewhat long-winded and complicated. He understood it after a good deal of effort, but it only repeated what he had already told them, that the dividend of the particular year being limited to 7 per cent., all the rest of the profit goes in aid of those years during which no dividend was paid, because the 7 per cent., according to contract between the partners, was to be cumulative. They had £117,000 of deferred shares representing Mr. Edison and his friends' proportion of the capital of the business, the consideration, in fact, for his patents, and so forth. He had never received anything at present, nor could he or they who held those shares until the shareholders in the company—that is, the "A" shareholders had received 7 per cent. not only in respect of the current year, but in respect of all the past years, and now they had wiped out, as they would see in that descriptive paragraph, everything up to June 30th, 1888. They still had on that account some considerable sum to meet out of the profits of future years before the deferred shares got anything. The appropriation of the profits as proposed was shown in the statement under the balance-sheet. The profits were brought down from the working account—£74,810 16s. 7d.:—To dividend for the year ending June 30th, 1892, at 7 per cent. per annum, £24,743 9s. 2d. To payment of cumulative preferential dividend on the "A" shares, for the year ending June 30th, 1887, at the rate of 7 per cent., £24,743 9s. 2d. To payment on account of cumulative preferential dividend on the "A" shares for the year ending June 30th, 1888, at the rate of 4 per cent., £14,139 2s. 4d. That exhausted £63,626, which was the amount they proposed to distribute out of the £74,810. The balance of £11,184 it was proposed to carry to the reserve fund. He next referred to the general paragraphs in the report, No. 3 and No. 4, stating that the directors were glad to say that the electrical fittings business was prospering, and the amounts received as royalties for sockets, &c., was satisfactory, and likely to increase year by year. He had told them in rather more words the same story. He had stated why they entered upon the manufacture, and that it was a growing asset, and one having the great advantage of being protected by patents for a good number of years. Paragraph 5, in very brief words, records what in the earlier days of the company would have been a positive calamity to them, and even in these days, when they had felt their footing and got this business upon something like a sound basis, was still a very serious loss, and that was the death of their old friend Mr. Leyland, which was almost awful in its suddenness. This loss created a vacancy, and they thought that, looking at the position which Major Flood Page had held in the company for a good many years, and that he, like some of the rest of them, was not getting younger as time went on, he might very properly be relieved of some of the harrassing details of the business which it had been his lot to attend to as secretary, and put upon the board in place of Mr. Leyland. Accordingly, they elected him as deputy chairman, and hoped the shareholders would confirm the judgment of the step taken. As to the balance-sheet, the figures, in so far as the capital was concerned, were exactly where they were in the previous accounts—they have not increased the capital. Then there were sundry credit balances which showed that

they owed £16,493, and against that item might be set debtors on the other side, which amounted to £30,809, and as those were all good, they could see that they were all right there. Next they came to the balance brought from the profit and loss account, £74,810 16s. 7d., from which was deducted interim dividend at the rate of 5s. 3d. per share on the "A" shares, £3 paid, 8s. 9d. per share on the fully-paid shares allotted to the Edison Electric Light Company, Limited, and 7s. 8d. per share on the fully-paid shares allotted to the Swan United Electric Light Company, Limited, paid on February 22nd, 1892, amounting together to £30,271, 15s. 11d., and leaving a balance of £44,539 0s. 8d. On the other side of the account was the old item brought forward year after year, showing where the money had gone to. This £234,638 represented the cost of patents, goodwill, preliminary outlay, loss on working, &c., as against £375,000 of "A" capital. Then came the assets: firstly, £12,000 in the Manchester Edison-Swan Company, Limited, which paid no dividend at present. He did not know whether it was within the bounds of possibility that that company would pay a dividend on their deferred shares. If they did that asset would be worth something; if not, it would not be worth much. Then came freehold property £39,458, and plant and stock £67,328. With respect to the freehold property, they bought a considerable acreage of land at Ponder's End, with enormous buildings thereon, for the purpose of a factory. The land and buildings were sold to them at a moment of great depression, and under circumstances which made the bargain for them exceedingly advantageous. The plant and stock represented the two items he had spoken of, lamps and so forth in hand, and the plant and machinery which they out of capital bought to make that factory a going concern. He supposed he might say that if they had to start afresh and find land in a position as advantageous, and put upon it buildings and plant as efficient as they had got now, it would cost a great deal more than those two sums represented, from which he drew the inference that as long as the business could be pursued, they had a factory and land bought very economically, with a capacity of production which was very large, for a good number of years as a going concern, which would be of great value to this company, and might be regarded as a very sound asset. Office furniture was put at the moderate figure of £173 7s. 8d. They had written down from year to year nearly the capital value of the few luxuries they possessed in the office. Their investment in consols at cost stood at £20,000, and the cash at bankers and in hand was £30,719. That was the state of their accounts, which were very simple. He moved, "That the report and accounts for the year ended June 30th, 1892, be received and adopted."

Major S. FLOOD PAGE seconded the motion.

Mr. LORRAINE said it was the common belief that upon the expiry of a patent the person who had held that patent for a number of years and had made considerable profit out of it by the sale of articles became a great loser, but in his opinion this was not so, for he actually made more out of his patent after it expired, the reason being that a hundred competitors coming into the field, the goods for which the former holder of the patent had established a reputation became largely advertised. He understood that the depreciation which had taken place in the company's shares was to be attributed to the fact that people imagined that as soon as their patents might expire their profits would disappear, but he held that this was not going to be the case. Consulting engineers had told him that for some years they would be afraid to specify any lamp except the Edison and Swan, as they knew the difficulties of manufacture. Another argument was that lamps would be introduced by other people from foreign countries where labour was very cheap, but he wished to inquire whether they would not avoid a loss by reason of the Swan Company having factories in those countries where the cost of labour is very low.

The CHAIRMAN expressed his and the board's concurrence in the remarks of the last speaker, and said they did not fear in the least that the profits would be diminished owing to the expiry of the patents. The expansion of electric light was marching on through the means of the various companies which had been formed, and this company had nothing whatever to fear from competition. If the conditions of labour as between employer and man were interfered with to such an extent as to affect the company, they would certainly consider the advisability of getting their lamps made abroad.

The resolution was then put and carried, and the following resolution was afterwards agreed to, viz.: "That a dividend be, and is hereby declared, on the 'A' shares of the company of 5s. 8¾d. per share on the 89,261 ordinary shares, £3 paid; of 9s. 6¼d. per share on the 5,000 £5 fully paid shares allotted to the Edison Electric Light Company, Limited; and of 8s. 10¾d. per share on the 12,139 £5 fully paid shares allotted to the Swan United Electric Light Company, Limited, free of income tax, being, with the interim dividend paid on February 22nd, 1892, 7 per cent. in respect of the year ending June 30th, 1892; 7 per cent. in payment of arrears of cumulative preferential dividend for the year ending June 30th, 1887; and of 4 per cent. in respect of the year ending June 30th, 1888; all to be distributed in accordance with the provisions of Clause 87 of the articles of association, and that the balance be carried to the reserve fund."

The retiring directors, the Earl of Lichfield and Mr. E. Villiers, having been reappointed, the auditors, Messrs. Welton, Jones & Co., were re-elected, and the proceedings terminated with the customary votes of thanks.

Electrical Power Storage Company, Limited.

THE third ordinary general meeting of this company was held on Wednesday last at the offices of the company, 4, Great Winchester Street, E.C., Mr. John Irving Courtenay presiding.

The SECRETARY (Mr. J. W. Barnard) read the notice convening the meeting, and the report and accounts were taken as read.

The CHAIRMAN then said: Gentlemen,—I intend to make but few observations to-day. The directors' report and balance-sheet I know you will consider as very satisfactory. The dividend of 6 per cent. has been earned by our secondary battery manufacturing business at Millwall during the 12 months that have elapsed since we took it over from the Electric Construction Corporation, and is for that period; you will be pleased to learn, that a most gratifying increase of business has taken place in that time. The financial position of the company is a strong one—a good balance of cash, nearly £10,000, at our bankers—and current accounts due to us upwards of £11,000, as against about half that amount owing by the company, and there is still a substantial amount of uncalled capital. I must here heartily thank our manager (Mr. Frank King) and our staff for the skill and energy he and they have displayed during the past year. The E.P.S. batteries continue to hold the field against all comers. The award of the only gold medal, given solely for secondary batteries at the Electrical Exhibition at the Crystal Palace, is a fresh proof of the unrivalled excellence of the E.P.S. batteries. Numerous secondary batteries continue to be introduced so far as blue books, specifications, laboratory experiments, and newspaper paragraphs can introduce them; but they all die shortly after their birth, and, in a commercial point of view, are heard of no more. During the last 10 years, scarcely a year has passed without some alleged improvement having been trumpeted forth as about to revolutionise the storage battery business, but the supporters of these inventions are now sadder if not wiser men. Because we make the best battery in the market we do not therefore say "rest and be thankful;" on the contrary, Mr. King is always on the *qui vive* to improve, if possible, the E.P.S. manufactures, and to keep the foremost position, of which you have tangible proof in the largely increased sales of the E.P.S. batteries for lighting and other purposes. For traction purposes especially we may look for an increased demand for the E.P.S. batteries, and close attention is being given to this branch of the business. I think there should now be a further development in our foreign business, which has been hindered by competitors in several directions, but the Courts in various countries are, I think, at last arriving at conclusions favourable to the interests of those who are supporting the patents, as for instance the decision of the Imperial Court of Appeal at Leipsic, by which the validity of the Faure patent in Germany is finally decided; and again, there is the judgment in favour of the Swan patent recently delivered in the United States. In this connection I may mention that the directors are also keeping a watchful eye upon what is being done by others in the storage battery business in this country, and it may yet be their duty to take steps for the more effectual protection, if it be found necessary, of our British business. I do not propose, on this occasion, to detain you longer, but will conclude by stating that I consider the prospects of the company are excellent. I beg to move the following resolution:—

"That the directors' report and statement of accounts to May 31st, 1892, be and are hereby approved and adopted, and that a dividend of 6 per cent. on the paid-up capital be declared, payable on the 21st inst."

Sir DANIEL COOPER, in seconding the motion, said it was well known that the old E.P.S. went over to the E.C.C. Company, and the business, when it got into other hands, decreased, but the ground that was lost they had regained, and they hoped to do a larger business in the present year than during the last. He made that statement to assure them that if the system of making secondary batteries was pursued as at present, it was almost impossible for anyone to make the same quality as they had been making, and which they would continue to make. He had no doubt the business would be as profitable without a monopoly of the patents, as it was when they had the monopoly. He felt quite confident himself that the company would prosper, and that they would get very good dividends for the capital they had invested.

The resolution was carried unanimously.

The retiring directors, Mr. Frederick Green and Mr. James Pender, having been re-elected, also the auditors, Messrs. Broads, Paterson and Co., the proceedings terminated with the usual vote of thanks to the chairman.

The Liverpool Overhead Railway Company.

A SPECIAL general meeting of the shareholders of the Liverpool Overhead Railway Company was held on Tuesday last week in the Law Association Rooms, Liverpool, Sir W. B. Forwood, chairman of directors, presiding.

Mr. ALSOP, solicitor to the company, explained the clause of the Act of Parliament under which they were met. The capital fixed by the original Act of 1888 was £450,000, with borrowing powers to £150,000, or one-third of the capital. Nothing, however, could be borrowed until half the capital had been issued, and then only £75,000, or half the amount finally borrowable. After that nothing more could be borrowed until the whole of the capital had been issued. The subsequent Act provided that £375,000 of the capital having been already issued, one-third of that should be borrowable, namely, £125,000.

The CHAIRMAN said he would explain why it had become necessary to apply for increased borrowing powers. Originally they had thought that the cost would be £450,000, made up of £375,000 capital and £75,000 bonds. Their original intention was to work by steam locomotive power. It had since been determined, however, very wisely, as he thought, by the directors, with the sanction of the shareholders, to adopt electricity. This change involved an increase of from £37,000 to £67,000 in the cost of their motive power. They had investigated the matter, and as a result had come to the full belief that the increase of £30,000 was fully justified by the greater economy which would result in the working—an economy of nearly 20

per cent. per annum. In like manner they had abandoned their original intention of using hand signals, at a cost of £3,000, and had decided to use the new electric automatic signals, which would cost £7,000. In this case, also, though the first cost was enhanced, the saving in manual labour through the automatic working would be very great. The progress of their undertaking had been much slower than had been anticipated. They had met with the numerous unforeseen difficulties which attended all new undertakings. They were, however, approaching the completion of their work, and the directors believed they could see their way to having the railway in operation in October. There were only 48 spans required to complete the main structure. The electric plant for the motive power and the carriages were complete, and they had their electric station at Wellington Dock well in hand—indeed, it was almost complete.

The CHAIRMAN then moved, and Mr. RICHARD HOBSON seconded, the following resolutions:—1. That the resolution passed at the general meeting of shareholders held on the 9th day of February, 1892, authorising the company to raise the sum of £75,000, by the creation and issue of debenture stock for that amount, be and the same is hereby rescinded. 2. That the Liverpool Overhead Railway Company, in exercise of the power conferred by the Liverpool Overhead Railway Act, 1892, be authorised to raise the sum of £125,000 by the creation and issue of debentures for that amount, and accordingly that the directors of the company be empowered to issue such debentures at such rate of interest, in such amounts and manner, at such times and on such terms, as they think fit.

The resolutions were carried unanimously, and the meeting terminated.

The International Electric Company of Vienna.

THE report presented to the sixth general meeting states that, in the business year 1891-92, to which the present report refers, this undertaking has passed from the stage of preparations, constructive and administrative.

The Vienna central station was certainly put in operation in November, 1890, but it did not reach the position of a normal business establishment in the autumn of 1891.

The number of applications for a supply of current for illuminative purposes amounted, by the end of the business year, to 32,000 lamps of the power of 16 normal candles, and 457 arc lamps of different powers. In comparison with the previous year, the applications have been more than doubled.

The connections have also increased in a satisfactory manner, so that a further increase to the number of 35,000 lamps may be provided for.

The supply of current for the transmission of power has also increased. We have furnished nine electromotors of from 1 to 10 H.P. each, and we have supplied them with current, by which a better utilisation of the work is effected, especially during the daytime.

Our activity has extended also to the arrangement of electrical installations.

In proportion as the arrangements of the Vienna central station have been improved, we have been in a position to reduce our scale of charges, which has again reacted favourably upon the extension of our circle of customers.

We have extended our distributive leads, which have now reached the total length of 75 kilometres.

The motor department has been extended by the erection of a new steam engine to the total capacity of 2,700 H.P., by which a probable consumption of current to the extent of 50,000 glow lamps (16-candle) can be provided for.

The construction and the arrangement of the Fiume central station for lighting and supplying power was completed in November, 1891.

We have carried out in the harbour of Fiume and in the territory of the State railways various iluminative installations, and we added electric elevators.

We have obtained from the municipalities of Bielitz and Biala the concession for erecting and working an electric central station for both these towns. The construction of this station, with a provisional capacity of 250 H.P., has been taken in hand.

Negotiations have been undertaken with other municipal bodies for the erection of installations and we look forward to the extension of our undertaking in other towns.

Among electric single installations we may mention that for lighting the Court and State printing offices at Vienna with about 1,900 glow lamps and 22 arc lamps, and the electric installation for 500 glow lamps together with the accessary electrical and mechanical arrangements at the Imperial Castle "Achilleion" in Gastein (?)

In the balance-sheet we have to remark that our stock of building materials and apparatus for installations amount, according to inventory, to 110,428 fl. 36 kr.

The effects specified in the balance-sheet, including ground rents, amount to 464,409 florins.

The values deposited as security for agreements are 84,776 fl. 34 kr.

The value of the central station at Vienna, consisting of fixtures, machinery, conductive net transformers, and electric meters, is found to be 3,141,783 fl. 29 kr.

The central station at Fiume with all its fittings and appliances represents a value of 261,027 fl. 23 kr.

The funds invested for our central station now in course of erection at Bielitz amount up to the conclusion of the accounts to 24,402 fl. 91 kr. These costs cannot be stated in detail until the completion of the works.

On the inventory acccount and the sum total of the stamps for shares we have, as in the former year, written off 20 per cent.

The debtor account of 263,414 fl. 20 kr. is composed of accounts for installations and the supply of current.

In the account for the Vienna central station we have, according to our laws, written off 44,979 fl. 27 kr. towards the sinking fund.

In the creditor's account of 160,148 fl. 84 kr., there appear chiefly items which we owe for supplies and work done, but not yet due.

On the profit and loss account we make the following remarks:—

The total is composed of salaries, taxes, and fees, and amounts to 42,985 fl. 40 kr.

Rents and interest amount to 42,073 fl. 51 kr.

The net profit amounts to 176,942 fl. 52 kr. Out of this we propose to pay a dividend of 150,000 fl., *i.e.*, 5 per cent., or 10 fl. per share. For the establishment of a renovation fund the sum of 5,000 florins, 2 per cent. of the net profit of 176,942 fl. 52 kr. must, according to our laws, be placed to the reserve fund, whilst the residual (after deducting the statutory quota of the council of management, *i.e.*, 16,840·37), 1,563·30 are carried over to the next account.

The Paris-New York Telegraph Company.

THE following letter, signed J. W. Mackay, jun., appears in a French contemporary *re* the affairs of the above company. "The unfortunate Paris-New York Cable Company is going through a new crisis. Will that crisis be decisive, and will it lead to a solution favourable to the unhappy shareholders who have placed confidence in the founder, M. Pouyer-Quertier, and his friends? We must hope so. I have often enough written that the council which succeeded him in 1886, by violently expelling him, did not introduce the remedies it had promised, and that it was necessary to get rid of it as unworthy of the mission it had usurped. In reality, this council only saw in the new post it had taken by assault, thanks to the support of foreign capital, a fat sinecure, where it hoped to live in peace without care for the grave interests of the shareholders whom it contributed to precipitate to ruin. How is it that five years have been necessary to open the eyes of the capitalists who placed it in that position? What has passed between it and the Commercial Cable Company group of New York? To summarise the facts, the council, originally directed by M. Dillon, is to-day suspected, and justly so, by the new shareholders, the most powerful of whom is the Commercial Cable Company. A few days before the annual general meeting of shareholders, which was announced for May 30th, this council saw, by the list of shares deposited, that it would be in a minority, and that its downfall would be pronounced. Not wishing to abandon the position, it at first decided that the meeting, on account of the insufficiency of shares deposited, could not validly be held. Its adversaries legally proved that the alleged fact was false, and demanded the holding of the meeting. On receiving a refusal, they held a meeting and announced the fall of the council, and named, as the new directors, MM. Magne, formerly director-engineer of telegraphs of the Paris district; A. Bouilliez, senator for the Pas de Calais; E. Bécue, a former official of the Telegraph Administration, and director of the Havre-New York Transatlantic Cable; G. Homberg, V. Hurtado, C. de Lussigny, Vicomte de la Mons-Saye, and E. Tuck, M. Magne being selected as president. This new council called upon the old one to hand over its powers, but it responded by announcing a general meeting for July 12th." After these incidents the Press sought Mr. Mackay, but he being absent, his son answered the allegations formulated in the following letter, which only slightly enlightens the discussion, for it does not clearly indicate the motive of the rupture between him and a council which only appears to be, in the eyes of the general public, the incarnation of its own interests. The following are the interesting passages of this letter:—"I shall not stay to seek the causes of the conflict going on between the French company and the English companies; this conflict, to which my father is absolutely foreign, is submitted to the law courts, and it is better to await the solution. It is affirmed that in 1886 my father became the owner of 21,000 shares of the French company, and that he bought them at a price of 155 francs in order to resell them later to the Commercial Cable Company at the price of 200 francs. I protest against such an imputation, which tends to nothing less than to accuse my father of having taken advantage of his position to speculate on the Commercial Cable Company, by making it pay 200 francs for shares which only cost him 155 francs. My father has purely and simply handed over to the Commercial Cable Company the shares of the French company at the price at which he bought them. In its turn, the Commercial Cable Company has sold these shares at the Bourse quotation. I bought a certain number of them on my own account, and my father, not having kept any for himself, found himself no longer a shareholder in the French company. It was also said that my father was opposed to the joining of the French cable with the Antilles cable, because, having acquired the Bermudas cable, my father would prefer a junction with the latter cable. Still more errors: my father had not become proprietor of the Bermudas cable, and the cable still belongs to the company bearing that name. Here are the facts as they occurred: In 1890, the French company sent M. Belleville to America to endeavour to obtain permission from the American Government to land in the United States a cable starting from Puerto Plata, thus connecting the French cable with South America. My father placed all his influence at the disposal of the French company, in order to get the required permission from the American Government. With that end in view, he accompanied M. Belleville from New York to Washington. The American Government would have granted that permission if the Submarine Telegraph Company had consented to give up the exclusive privilege which the Brazilian had conceded it; but the Submarine Telegraph Company had no intention of renouncing its privilege, and, in face of this refusal, the American Government would not accede to the French company's demand. Not only did my father, in 1890, do his best to obtain satisfaction for the French company, but he is still ready to undertake anything necessary to secure that object. My father has never ceased to show to the French company all the interest which

he has in it, for, on several occasions, he has not hesitated to advance to that company, without interest, large sums, of which he did not even claim repayment, knowing very well that a claim of that kind would considerably impede the company. It is also said that my father wishes to 'corner' the French company, in order to be alone in transmitting dispatches from the continent. They are mistaken. The director, and those who have insinuated this perfidy, should have added that, by the terms of an agreement between the French company and the Commercial Cable Company the latter, in case of a breakage of the French cable, is obligated to transmit *gratuitously* all the dispatches to the French company. The question of connecting the cable with South America could be easily settled and at small cost, despite the refusal of the Submarine Telegraph Company, if the directors of the French company were not resolved on the chimerical idea of obtaining from the American Government the permission which it has already refused, and that by the employment of intermediaries as powerless as onerous. The Bermudas Cable Company has proposed its cable as far as Puerto Plata; there was thus established, in a short time and at little expense, the line placing France and the Antilles in communication by the French cable. There is the gist of the question; it is useless to seek elsewhere. Let us notice the conflict existing between the council of the French company and a large group of shareholders which have been called the American group. This conflict arises from the excessive expenditure of the council, an expenditure which, each year, goes on increasing and absorbing all the profits of the company, to such an extent that not only can the company no longer pay dividends to the shareholders, but that it cannot even pay its debts. This year, the council knew that these shareholders, discontented with an administration of which waste was the first rule, called for regular and exact accounts. The statutes imposed on the council the obligation of rendering the accounts at the latest during May; naturally, the council fixed the meeting for the latest day, that is to say, the 31st. When, from the deposit of the shares, it saw the composition of this meeting, the council, greatly threatened and sure of falling, by every means, even the most illegal, prevented that meeting being held, and to justify the adjournment of the statutory meeting of May 31st, it was pretended that irregularities had occurred in the deposit of shares. What are these irregularities? Why not divulge them? And, if they exist, which they do not, has not the council committed them in accepting irregular deposits? And in order to justify the adjournment of the statutory meeting of May 31st, it was pretended that an action had been taken against the council by a shareholder who had not deposited his shares at the proper time; but this was settled by the judge before whom it was introduced, and, at the moment the council alleged an exception to this, it no longer existed. All these inventions are only subterfuges, as big as they are awkward, with which the Courts will promptly deal. Such is the truth without disguise or reticence. The conflict, then, does not exist between French and Americans. It exists between shareholders, enemies of waste, and a council which neglects the interests of the company too greatly. The French company will remain what it still is—a French company; but it must be administered by people who have no other care than that of doing their own business. As for me, I am just simply a shareholder like the others; on that account I protest against the waste which takes place in the French company; it is my right and my duty; I am not alone in manifesting this, since a large number of shareholders, representing more than 24,000 shares, are of the same opinion."

Société Générale des Téléphones.

AT the ordinary general meeting of the shareholders of the above company, the following resolutions were proposed and unanimously adopted:—1. The meeting, after hearing the reading of the directors' report, and that of the officials charged with the verification of the accounts for 1891, approve those accounts, as presented to them by the managing directors. 2. The meeting approve the division of profits as proposed by the directors, and fix at 20 francs per share the dividend for 1891, without deduction for taxes resulting from the finance laws, leaving to be carried over to the profit and loss heading of 1892 a sum of 103,946 francs, the payment of the dividend to be made at once. 3. The meeting appoints as directors MM. Halfon, Vernes, and Ernest Vlasto, retiring directors. 4. The meeting specially authorise M. Lazare Weiller, conformably to the stipulations of Article 40 of the law of July 24th, 1867, to exercise his duties as a director, at the same time remaining managing director of the Société Propriétaire d'Angoulême, from which the Société Générale des Téléphones procures the copper wire and silicious bronze used in its business. 5. The meeting, conformably to the stipulations of Article 40 of the law of July 24th, 1867, authorise MM. Lair, May, Vuigner, and Walterstein to retain their office as directors while at the same time exercising the same functions in the Société Française des Téléphones Sous-marins, for which the Société Générale des Téléphones executes orders. 6. The meeting appoint as auditors of the accounts for 1892, MM. Kulp, Petit, and V. de Saint-Marie, with the stipulation that in case of decease, hindrance, or resignation of one or two of them, it shall not be necessary to provide for their replacement, the others acting alone. Their fee is fixed at 1,200 francs each.

Sheffield Telephone Exchange and Electric Light Company, Limited.

THE third ordinary general meeting of this company was held at the Cutlers' Hall, Sheffield, last Monday. The report of the directors was adopted. The sum of £795 6s. 11d. was added to the reserve fund, and a dividend at the rate of 5 per cent. per annum was declared upon the ordinary shares. At an extraordinary meeting subsequently held, it was decided to reconstruct the company, under the title of "The Sheffield Electric Light and Power Company, Limited," having for its object the exploitation and development of the Parliamentary powers recently granted to the company for the electric lighting of a compulsory area in the centre of the town, and also the application of electricity to commercial requirements generally, respecting which there is a largely-increasing demand The directors propose to pay off all the preferential shareholders with interest to date, and to reduce, to some extent, the capital of the company, this course being rendered possible by the sale of the company's telephone exchange.

Manchester Edison Swan Company, Limited.

THE annual meeting of this company was held on Monday last at the Victoria Hotel, Manchester, Mr. V. K. Armitage, Chairman of the company presiding. In the directors' annual report, which was submitted, it was stated that the net profit for the year, including last year's balance, amounted to £2,826 1s. 10d. Out of this it was proposed to pay a dividend at the rate of five per cent. per annum, which will absorb £1,000, to carry £1,000 to reserve fund, and to carry forward a balance of £826 1s. 10d. On the motion of the Chairman, seconded by Mr. W. P. James Fawcus, the report was adopted, and the dividend recommended therein was declared payable. Mr. Armitage was re-elected a director of the company. Thanks were accorded to the directors for their services.

Globe Telegraph and Trust.—The report of the directors for the year ended July 18th shows that the net revenue of the company, after deduction of expenses, amounts to £192,243, and makes, with the balance of £1,876 brought forward, a total of £194,120. From this amount there has been distributed the sum of £133,059 in interim dividends, leaving an available balance of £61,061. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares and of 3s. 9d. per share on the ordinary shares, making, with the former distributions, a total dividend for the year of 6 per cent., less income tax, upon the preference, and 4¾ per cent. net (against 5¼ per cent. for the preceding year) upon the ordinary shares, and carrying forward a balance of £938.

The Equitable Telephone Association, Limited.—A general meeting of the members of the above company will be held at the liquidator's (Mr. C. L. Nichol) office, 1, Queen Victoria Street, on August 15th, 1892, at 12 o'clock noon, for the purpose of having an account laid before them, showing the manner in which the winding up has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator.

Anglo-American Telegraph Company, Limited.—It has been resolved to declare an interim dividend for the quarter ending June 30th, 1892, of 12s. 6d. per cent. on the ordinary stock, and 25s. per cent. on the preferred stock, less income tax, payable on July 30th to the stockholders registered on the books of the company on July 11th, 1892.

St. James's and Pall Mall Electric Light Company.—The directors have declared an interim dividend at the rate of 7 per cent. per annum on the preference shares, and 5 per cent. per annum on the ordinary shares for the half-year ending June 30th, 1892.

United River Plate Telephone Company, Limited.—The directors' report states that after payment of all expenses there remained an amount of £32,106, from which had to be deducted the loss on exchange of £31,741, thus leaving a balance of £365, which is to be carried forward.

Newcastle and District Electric Lighting Company.—The directors of the Newcastle and District Electric Lighting Company, on Tuesday last, declared an interim dividend at the rate of 5 per cent. per annum for the half-year ending June 30th. This is the same as the dividend paid for the corresponding half of last year.

City and South London Railway.—A dividend at the rate of ¼ per cent. per annum is recommended by the board on the ordinary shares for the past six months, leaving a surplus of £983 to be carried forward.

The Kensington and Knightsbridge Electric Lighting Company, Limited.—A dividend has been declared at the rate of 6 per cent. per annum on the first preference shares in this company for the half-year ending June 30th last.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 17th, 1892, amounted to £766; corresponding month, 1891, £689, increase £77; total receipts to date for half-year, £2,262; corresponding period, 1891, £2,100; increase £162.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 15th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, amounted to £2,559.

The West India and Panama Telegraph Company. The receipts for the half month ended July 15th were £2,091, against £1,973.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation, July 14th.	Closing Quotation, July 21st.	Business done during week ending July 21st, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —103	99 —103	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48 — 49	48 — 49	48	...
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	88 — 89	88 — 89	88⅜	88⅛
2,849,510*l*	Do. do. Deferred	Stock	10½ — 11	10¼ — 11	11	10⅝
130,000	Brazilian Submarine Telegraph, Limited	10	10¼ — 10⅜	10¼ — 10⅜	10⅜	10 7/16
53,200*l*	Do. do. 5 p. c. Bonds	100	101 —104	101 —104	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞ — 3⅛	2⅞ — 3⅛	2 15/16	...
69,996	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2⅛ — 2⅜	2 5/16	2 3/16
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2½ — 3½	2½ — 3½	...	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	9¾ — 10¼	9¾ — 10¼	10 1/16	...
$7,716,000	Commercial Cable, Capital Stock	$100	155 —160	155 —160	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	⅛ — ⅜	⅛ — ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½ — 6	5½ — 6	...	...
16,000	Cuba Telegraph, Limited	10	11 — 12	11 — 12	11⅞	11½
6,000	Do. do. 10 p. c. Preference	10	16½ — 17½	16½ — 17½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼ — 3⅜	3¼ — 3⅜	3⅜	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜ — 11⅝	11½ — 11⅝	11⅝	11½
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ — 15⅛	15 — 15¼	15 3/16	15
70,000	Do. 6 p. c. Preference	10	15½ — 16	15½ — 16	...	...
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	108 —111	109	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	108 —111	108 —111	110⅜	110
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞ — 15⅛	14⅞ — 15⅛xd	15 3/16	14⅞
78,300*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	104½	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	108 —111	108 —111	...	...
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	102 —105	102 —105	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	5¼ — 5⅝	4⅝ — 5¼	5	4⅜
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1⅜ — 1⅝	1¼ — 1½	1 3/16	...
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	2⅜ — 2⅝	2 — 2¼	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1⅞ — 1⅝	1⅛ — 1⅜	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	10⅛ — 10⅜	10⅛ — 10⅜	10⅜	10 3/16
180,042	Do. do. 6 p. c. Preference	10	15⅛ — 15⅜	15⅛ — 15⅜	15 5/16	15 3/16
150,000	Great Northern Tel. Company of Copenhagen	10	18½ — 19	18¼ — 19	18½	...
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	106 —109	106 —109	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 466*l* to 14,000 ...	10	7⅞ — 8¼	7⅞ — 8¼	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½ — 10½	9½ — 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	20 — 21	20½ — 21¼xd	21	20½
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	104 —106	104 —106	...	...
17,000	Indo-European Telegraph, Limited	25	40 — 42	40 — 42	40½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ...	10	3½ — 4½	3½ — 4½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8 — 9	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 7/16 — 3 9/16	3 7/16 — 3 9/16	3⅛	3⅛
10,000	Do. do. fully paid	5	5 3/16 — 5 5/16	5 3/16 — 5 5/16	5⅛	4⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	107 —110	107 —110	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6¼ — 7	6⅜ — 7¼	7	6⅜
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅞ — 5⅛	4⅞ — 5⅛	5 1/16	4 15/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	13½ — 14½	13½ — 14½	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12⅞ — 13½	13 — 13½	13¼	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	108 —110	109 —111	110⅜	109
250,000*l*	Do. (issued at 5 p.m., all paid)	...	108 —110	109 —111	...	...
6,318	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	4 — 5	4 — 5	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 — 5/16	3/16 — 5/16	...	...
9,000	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅞ — 8¼	7⅞ — 8¼	7⅞	7⅞
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8⅛	7⅞ — 8⅛	8	...
3,381	Submarine Cables Trust	Cert.	115 —120	115 —120	118	...
78,949	Swan United Electric Light, Limited ... ... (£3¼ only paid)	5	3¼ — 3⅜	3 — 3¼	3¼	2¼
37,350	Telegraph Construction and Maintenance, Limited	12	45 — 47	44 — 46 xd	45½	44½
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	103 —106	103 —106	...	...
58,000	United River Plate Telephone, Limited	5	1½ — 2½	1½ — 2½	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6 — 8	6 — 8	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	101 —105	100 —103	102½	...
30,000	West Coast of America Telegraph, Limited	10	3½ — 4½	3½ — 4½	3 3/16	3½
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	101 —105	101 —105	...	...
67,007	Western and Brazilian Telegraph, Limited	15	8⅜ — 9¼	8⅜ — 9¼	9	8⅞
30,364	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½	...	...
30,364	Do. do. do. 5 p. c. Deferred	7½	2¼ — 3¼	2⅜ — 3¼	3 1/16	...
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	105 —108	107	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph, Limited	10	1¼ — 1½	1¼ — 1½	1½	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9½ — 10	9½ — 10	9½	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8 — 9	8 — 9	8	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	102 —106	102 —106	...	...
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	100 —103	100 —103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6¼ — 6⅝	5⅝ — 6¼	6	5⅝

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£5 paid 7¼—7⅜.—Electric and General Investment, shares of £5 (£1 paid), 2⅜—3⅛.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6¼—7⅛.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20⅛.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2½—3⅛.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅞—6, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅛—6.—Manchester, Edison and Swan Company, £9 (£1 paid), ¼—⅜.—Metropolitan Electric Supply Company, Founders' Shares, 50—150.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—¼.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—¼.—Do. Debentures, 103—¼.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ¼—½—£5 Preference (fully paid), 2⅛—3.—Ward's Electric Car (£10 paid), 1⅛—1⅜.

BANK RATE OF DISCOUNT.—2 per cent. (April 28th, 1892).

PROCEEDINGS OF SOCIETIES.

FEBRUARY 26th, 1892.

Prof. W. E. AYRTON, F.R.S., Past-President, in the chair.

Prof. S. P. THOMPSON, F.R.S., read a paper ON MODES OF REPRESENTING ELECTROMOTIVE FORCES AND CURRENTS IN DIAGRAMS.

The author said he had found it advantageous in some cases to depart from the usual methods of representation, and he now brought the subject before the Society in order to have it discussed and improvements suggested. To indicate the directions of currents in wires seen end-on, Mr. Swinburne had used circles, with and without crosses, but no symbol had been suggested for wires not conveying currents. He (Prof. Thompson) thought the plain circle should be used for inactive wires. A circle with a dot in the middle could then be used to indicate that a current was flowing towards the observer, and a circle with a cross in it to represent a wire conveying a current away. These meanings could be recalled by considering the direction indicated by an arrow, the dot showing the tip of the arrow, and the cross the feathers. Some method of distinguishing between E.M.F. and current was required. For this he proposed to use thin stemmed arrows with feathers for E.M.Fs., and thick stemmed ones without tails for currents. In the case of electrical transmission of energy, this convention had the important advantage that where the two arrows had the same direction, energy was being given to the system, and where the arrows were opposite, energy was leaving it. Mr. Maycock, he said, had recently published a simple rule for finding the direction of magnetic force due to a current of known direction in a wire. Grasp the wire with the right hand, the thumb pointing in the direction of the current; the fingers will then encircle the wire in the direction of the magnetic force. Dr. Fleming's well known rule for induced currents was also a *right-hand* rule; but as it referred to the direction of *currents*, another rule was necessary when considering motors. By making the rule refer only to E.M.Fs., only one rule was required for generators and motors. For alternating currents the author had found it convenient to draw polar curves analogous to Zeuner's valve diagrams. Suppose a line, O P (fig. 1), representing the maximum value of an E.M.F. or current

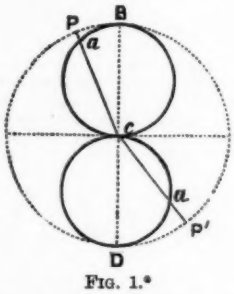


FIG. 1.*

whose magnitude is a sine function of the time, to revolve at uniform velocity about O; the intercepts O Q, O Q^1, &c., cut off by circles, O Q B, O Q^1 D, will represent the magnitudes at the times corresponding to the positions, O P and O P^1. The effect of lag can also be represented in such diagrams. In cases where the variables are not sine functions, the curves, O Q B and O Q^1 D, are no longer circles. Polar diagrams, representing the E.M.F. and current curves obtained by Prof. Ryan in his transformer experiments were exhibited, and a working diagram illustrating the changes in three-phase currents was shown. To show the directions of induced E.M.Fs. in diagrams of dynamos and motors, diagonal shading of the pole faces was sometimes convenient; the lines over north poles being drawn from left to right downwards in the direction of the middle stroke of the letter N, and those over south poles from left to right upwards. A conductor passing over a north pole from left to right would have an E.M.F. induced in a downward direction, as indicated by the slope of the diagonal lines. This method of representation was used to show the ways of connecting up multipolar drum armatures, the winding being supposed cut along a generating line, unwrapped from the core and laid out flat, in the manner adopted by Fritsche. In connection with armatures, the author said a formula had been published, by means of which the nature of a winding consisting of a given number of convolutions, and to be used with a given number of poles, could be predetermined. This, he thought, would be very useful in practice.

Mr. BLAKESLEY said the old method of representing alternate current magnitudes by means of the projections of revolving lines seemed preferable, for it left no ambiguity as to the directions of the quantities. The method of shading the poles also required that the direction in which the diagram was to be viewed should be known before the direction of the E.M.F. could be determined.

Mr. SWINBURNE suggested that the author might use a bow to represent E.M.F., and an arrow for current. He was glad to see that Prof. Thompson recognised the differences in dynamos and motors, and approved of the view that mnemonic rules should refer to E.M.F. and not to current. The diagrams of drum windings would be very useful, and he hoped the author would make the subject clear to ordinary workmen in the next edition of "Dynamo-Electric Machinery."

Prof. PERRY considered it undesirable to use polar curves for anything but circles. In his opinion it was not sufficiently known that any curve can be split up into a series of sine curves, and each component dealt with separately; the separate results being added together in the end.

Mr. SWINBURNE pointed out that before one could analyse a curve in this way the curve must be known, and would probably have to be determined experimentally. If means for finding one curve are available, any other required curve could probably be found by the same apparatus, hence there was no need for analysis.

Prof. PERRY remarked that experiments could not be made on a machine before the machine was built, whereas the E.M.F. curve could be predetermined from its design. By analysis, its current curves when working under various conditions could be found.

Prof. AYRTON, referring to the mnemonic character of the modes of representation described by Dr. Thompson, suggested that the symbols in the author's book should be more mnemonic. He, himself, was in the habit of using large letters for currents and small ones for resistance; A and a for the armature, S and s for series, and Z and z for the shunt, currents and resistances respectively, and σ and ζ for the series and shunt turns. He also found the following "electromotive force" rule very convenient:—Draw three rectangular axes, O M, O F, and O E, as shown in fig. 2. If, then, O F represents the direction

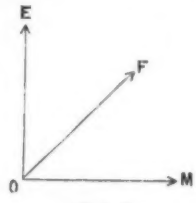


FIG. 2.

of the force (magnetic), O M that of the motion, then O E shows the direction of the induced E.M.F.

Dr. THOMPSON in replying, said he thought Mr. Blakesley had misunderstood what had been said, for no ambiguity existed. In describing the windings of armatures, difficulty arose from want of proper names for the various elements, and in his forthcoming work suitable names had been given. To Prof. Ayrton he pointed out that in his book, he (Dr. Thompson) had used mnemonic characters, for r_a, r_s, and r_m represented the resistances of armature, shunt and series magnet coils respectively. The symbol I for current had also been recommended for adoption by the Frankfort Committee. He objected to Greek letters except for specific quantities, such as angles, specific inductive capacities, refractive indices, &c. He appreciated the simplicity of Prof. Ayrton's E.M.F. rule, but thought it would be better to rotate O E and O F through a right angle about O M, thus giving fig. 3.

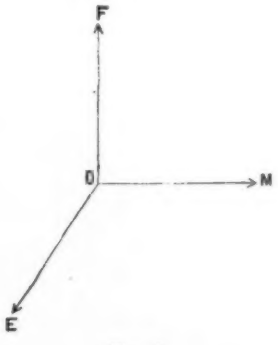


FIG. 3.

A paper on Choking Coils, by Prof. Perry, F.R.S., and a description of the uses of Rice's choking coils for regulating the brilliancy of incandescent lamps, by Mr. Hammer, were postponed until next meeting.

* In this diagram the a's should evidently be Q and Q', and the c, O.—EDS. ELEC. REV.

A FEW MONTHS' WORKING OF THE JARMAN ELECTRIC CAR UPON THE CROYDON COMPANY'S TRAMLINE.*

BY A. J. JARMAN.

[COMMUNICATED.]

TWELVE months ago I had the pleasure of reading a paper before you upon that method of electrical traction that bears my name; and after giving you a detailed description of the mechanism and storage battery connected with this system, I promised to give some further information upon the practical working of the battery when we met together again.

I am now able not only to give you some information respecting the every day working of my patent storage battery, as well as that of another well-known make, but also about the working of the electric motor, gearing, &c., which I fully described to you just a year since.

Towards the end of last year an agreement was entered into with the Croydon Tramways Company for the running of electric cars fitted under my patents.

It was contemplated to run a regular two-car service, but with only two cars at my disposal, one alone could be kept in regular work, it

* Read before the Tramway Institute, June 28th, 1892.

being necessary to have one car ready to take the place of the other when this had to be taken to the charging station to recharge the batteries. Had the charging station been at the end of the line, a two-car service could be maintained and time kept with three cars, but situated as the charging station is, in the middle of the line, it would require four cars to maintain a regular two-car service; but these four cars could, with the depôt at either extremity of the line, maintain a three-car service, allowing one car in reserve. Before entering upon the account of the work done, I may state (and I trust the chairman of the Croydon Tramways Company may not disagree with me) that the conditions under which the running took place were not the most favourable.

The flanges of the car wheels were too deep for the rails, and had to be ground down in running before the cars could run smoothly, the tread of the wheels being $\frac{3}{16}$ths above the rails, owing to the wheels having been made to suit another section of tram rail; the points, also, were not good enough for the electric cars, which would occasionally miss the points, and consequently ran off the line. These circumstances, as you understand, were not favourable to the cars, and much extra power was consumed, and the motive machinery was subjected to strains which would not have come upon it on a line prepared for electric traction.

The first car commenced to run in every-day service in January of the present year, and ran for several weeks, carrying a considerable number of passengers; I remember on one occasion as many as 84.

Well, after several weeks running the vulcanised fibre teeth (which I used in my gearing wheels, and which I adopted with a view to noiseless running) gave way, the mishap occurring through reversing the electric motor, and bringing the car up to a dead standstill whilst running at its normal speed, so as to avoid running over a horse which had strayed across the tramline at night, and at a very dark part of the road; the life of the horse was saved at the expense of the car gearing. On examination of the wheels fitted with the fibre teeth, I came to the conclusion that these teeth were not adapted for every-day work. Upon careful examination, it was found that these teeth had commenced to laminate, the lamination being caused through their running constantly in oil, to keep them well lubricated. In all the previous experimental runs, extending over a year or two, a mixture of tallow, lard and plumbago was employed as a lubricant, and with this lubricant no defect was observed to take place with the fibre teeth.

I took out all the vulcanised fibre teeth, and replaced them with hard gun metal; these teeth worked well, and I did not observe any perceptible increase in noise by their adoption. Last Easter Sunday one of the cast iron mortice wheels, fitted with these teeth, broke in the main body into four pieces, all the gun metal teeth remaining intact. I cannot now avoid coming to the conclusion that cast iron, in any shape or form, is not suited for the gearing of self-propelled vehicles, no matter how thick it may be employed.

Cast iron cannot withstand the shock and concussion which it must inevitably be subjected to in tramway work. Cast iron mortice wheels were used only in the gearing of No. 1 car, not constructed by me; the gearing in No. 2 car, which was designed and put together entirely by me, was fitted with wheels cast in phosphor bronze, known as No. 7 alloy, and these wheels I have found to perfectly withstand the shock and strain incurred in tramway work so far, without becoming brittle or crystalline in their structure. Although I had allowed half an inch for the side play of the mortice wheels and wrought iron pinions, it has been found from everyday practice that a greater space should be allowed, particularly for the rounding of a curve and the occasional crossing of the wheels when running over very much worn points, and this practical result leads one more than ever to adopt the simple and plain form of tooth for gearing, which I have always advocated in place of either helical or worm gearing, as the side play of the car axle must impose a considerable side thrust upon the worm wheel and screw, and upon the sides of the teeth in helical gearing, and result in great friction and consequent loss and waste of power.

There cannot be any doubt that some tram lines are very much heavier to run upon than others, particularly so where the groove in the rails is shallow, and becomes filled with dirt, thus absorbing an enormous amount of power in grinding the dirt to powder through the difference in the circumferential velocity of the flange of the car wheel to that of the tread. This applies to every method of traction upon tramways, where a flanged and grooved rail is used.

The phosphor bronze alloy of which I have spoken, is capable of bearing a strain 16 tons per square inch, and the gun-metal teeth 14 tons per square inch, these latter teeth working very satisfactorily with a wrought iron pinion when kept well lubricated, by dipping into the well known green oil so much used for tramcar axles.

Having given you my experience with the gearing of the cars, I wish to say that it has been with this part of the mechanism that the principal difficulties have been experienced, and now this difficulty has been entirely overcome. I now come to the electric motor, and this, like the gearing, has been put thoroughly to the test, and I am very pleased to say it has withstood all the strains of every day work that have been imposed upon it. It is true that one armature had to be renewed through defective insulation, but this was in car No. 1, the motor of which as I have before mentioned was not made by me, in every other respect the motors have proved themselves perfect for tramcar work. Notwithstanding the heavy loads of passengers they have occasionally moved, they have been enabled to keep the cars up to their running time, and not interfere with the horse traffic, thus proving that they are equal to the task imposed upon them in carrying their loads, keeping time, and being both electrically and mechanically efficient, and demonstrating what is of vast importance to tramway companies, viz., that an efficient accumulator system enables the companies to gradually change the system from horse to electric traction without being burdened at the outset with the enormous capital outlay necessary for an installation by the direct current system; at the same time my electric cars are equally applicable to a line worked by direct current.

My patent carbon brush holder and the method of feeding the carbons as they wear away has proved itself a success in every particular, running for six weeks without renewal of carbons; an efficient little piece of mechanism like this is of the utmost importance where the electric motor is employed for traction purposes, as it enables the motor to run quite sparkless at the commutator.

I now come to the storage battery, and as I promised a year ago to say something about this much abused, and less understood, electrical accessory, I will redeem my promise. It is but a few years back that the cost of traction by accumulators was an unknown quantity, but to-day all is changed, in fact, I think I may say that the cost of accumulator traction has become a known quantity since my paper was read before you twelve months ago. You will remember in the concluding statement of that paper, I said, "the cost of maintaining the batteries in an efficient state, from what I have before mentioned, I do not think will exceed in a large installation 1d. per mile." Speaking now from experience, I estimate the depreciation and renewal cost upon 104 battery elements, being the number used in my cars, at 1d. per car mile run. If confirmation is required of the correctness of my estimate, I think it is afforded by the fact that a large firm of storage battery makers are prepared to maintain the batteries they supply for traction work at 1d. per car mile run, with some small percentage upon receipts or profits, thus amounting to just about 1¼d. per mile for depreciation, and this only goes to support the calculations I made a long time previous and also what I have been able to ascertain in practice upon the Croydon Company's line.

There has not been a single battery element renewed in either of the two cars at Croydon from the day they started running, and I am strongly of opinion, based upon observation, that there is more harm done to the storage battery when standing idle than when it is in daily use, because the acid solution has more time to act chemically upon the spongy metal and the subsalts that are formed, than it would do in every day charging and discharging. I attribute in a great measure the lasting qualities of the accumulators in these particular cars to the good quality of the electric motor, and to the fact that the flow of current is small, compared with other motors, to start the loaded car from the state of rest, and thus the cells do not become over discharged, as has been the case hiberto. My motor has been designed to suit the storage battery and to make it enduring, and practice up to now has confirmed my contention that I have attained this desirable end.

I now come to that part of the subject with which you all are more interested and that is, what does the accumulator system cost to work and will it pay? Upon this point I will be as exact as I can, basing my estimates upon actual practice, because I do not want you to suppose that my enthusiasm is so strong as to lead me to think that because a tramcar can be moved and propelled by electricity, that is all that is desired, nor to think that all the horses are to be wiped off the face of the earth because the question of electrical traction has made such great progress. I have stated before, and I state again, that this method of traction by electricity will stand only by virtue of its commercial value.

Now the principal items of cost are:—

1. Fuel.
2. Renewal of batteries.
3. Wages.
4. Repairs and renewals—oil, grease and stores.

Now, I found from experience at Croydon that the fuel consumed, using a double cylinder, high-pressure portable engine (an expensive fuel consumer) was 1½d. per car mile run on a wet day up to 2d. per car mile run on a dry day. With dear fuel and such an engine, this cost is far higher than would be the case with a modern type engine and running a number of cars. As to the cost of fuel, I think we may safely take the figure named in the ELECTRICAL REVIEW, February 20th, 1891, as to the cost of fuel on the Barking line, viz.:—1·033d. per car mile run over 100,000 miles. The wages per car mile run I am unable accurately to fix, but as the wages on our large horse tramlines, where necessarily a large number of men are employed as horsekeepers, &c., amount to less than 1d. per car mile run, we may be certain that the wages on an electric line would be far less; the cost per car mile of the renewal of batteries I have already treated of. The miscellaneous expenses, such as depreciation and repairs, oil, grease, &c., I will put down at another 1d., and in stating this figure I am again supported by the published figures of the Barking Road running before alluded to, although more than half of this 1d. per mile, viz., ·599d. per mile, comprised in that instance repairs to motors and gearing, a rate which I may confidently state would not be reached with my system.

We have thus per car mile run:—

Fuel	1d.	Total 4¼d. per car mile run.
Renewal of batteries	1¼d.	
Wages	1d.	
Renewals, repairs and sundries ...	1d.	

One thing has been found at Croydon and that is, the public take to these electric vehicles, they like the easy riding, they like their rapid travelling which so often has enabled persons to catch their trains, they like the well-lighted interior and the general advantages these cars offer, considering, moreover, the fact that they can carry heavier loads of passengers than horse cars, it is evident that they can be made to pay well upon the lines where they may be adopted where horse cars would not pay, and that 90 miles per day could be run by these cars just as well as 70.

There are many tramlines in this country that never have been worked at a profit, and never will be, where horse traction is employed. Those who have invested their capital in the laying down and equipping of these lines have long seen that their salvation lies in cheaper traction. I am convinced that if there is one force more

than another that will prove effectual in accomplishing this desired object, that force is electricity.

Unforeseen difficulties always have arisen in the development of every invention and industry. We all have to learn and be taught by that one great master—experience.

The self-contained electric car embodies all the elements for successful working. It matters little what may have been done in the past, or what errors may have been discovered in the early stages of experimental work for the propulsion of tramcars by electricity; depend upon it, the time will assuredly come when the accumulator car will take a firm footing upon our tramlines, because of its many advantages over every other form of traction.

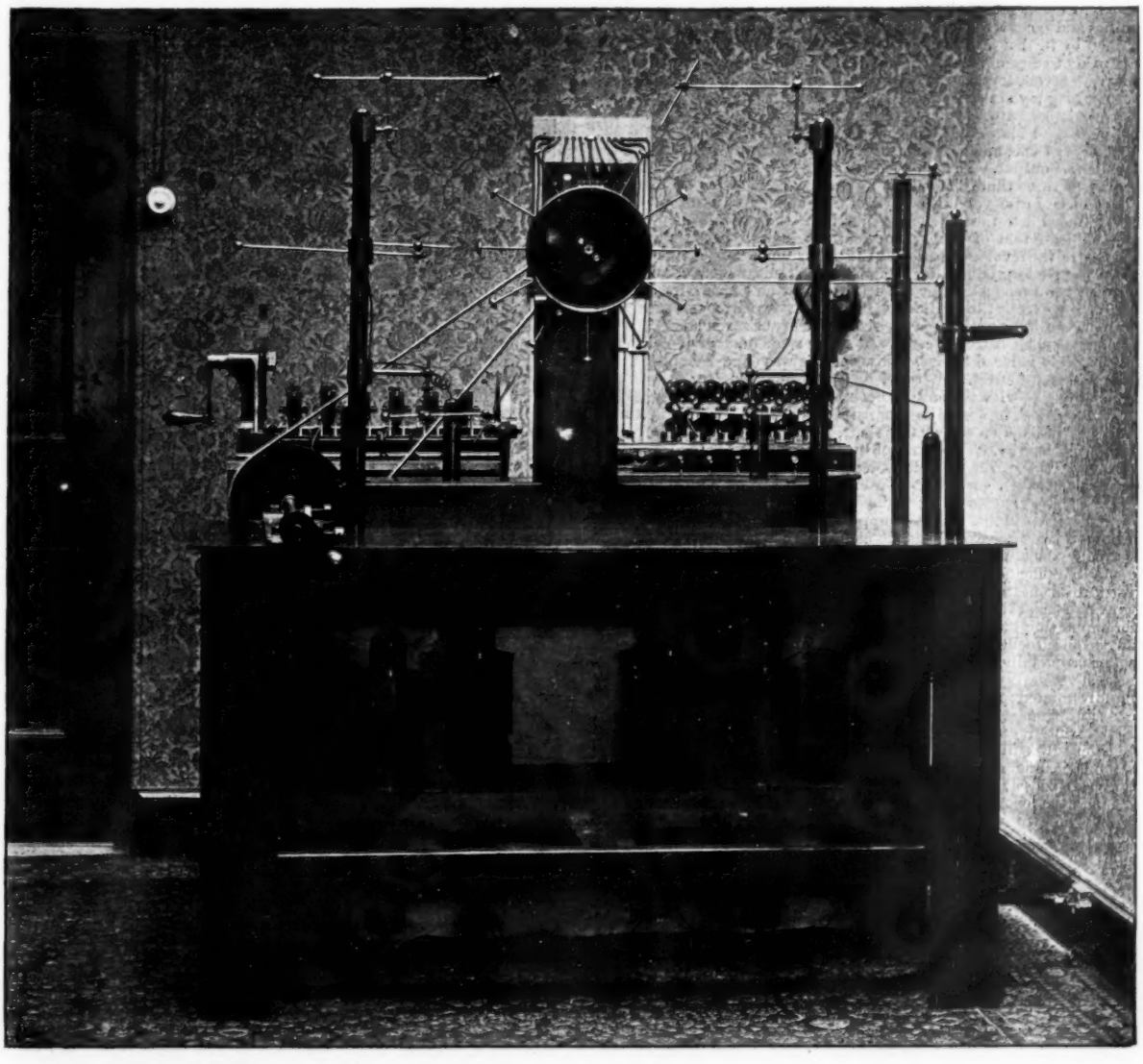
ON A MULTIPLE INDUCTION MACHINE FOR PRODUCING HIGH TENSION ELECTRICITY, AND ON SOME REMARKABLE RESULTS OBTAINED WITH IT.*

BY LORD ARMSTRONG, C.B., F.R.S.

IT is now nearly half a century since I undertook to design for the Polytechnic Institution then existing in London, a large hydro-electric machine, on the plan of the smaller one I had previously designed for myself. It was a very short time in my hands after its completion, and I had scarcely any opportunity of afterwards using it in the lecture room of the Institution. My experience with it was, however, sufficient to show me that its great power was very much less when used in a room than in the outside atmosphere when dry. I have ever since entertained the idea of constructing a similar machine of equal or greater power for my private use; but, until lately, the exigencies of business pursuits precluded my giving attention to the subject.

On recommencing my experiments on this branch of electrical science, my immediate object was to improve the frictional apparatus of the steam jet, so as to obtain the greatest effect from a given expenditure of steam, while my ultimate intention was to construct a large machine with such a number of jets as would afford me a more copious supply of frictional electricity than could be obtained by any other convenient means. I soon found, however, that the difficulty of obtaining effectual insulation in the open air, except under the most favourable conditions of weather, would involve great interruption and disturbing effect, and I therefore turned my thoughts to the induction coil as a source of high tension electricity, that would not only be independent of the caprice of the weather, but would also save me from atmospheric inclemency, which, however harmless it might have been in the youthful days of my hydro-electric experiences, could not be safely endured at my present advanced period of life.

I did not flatter myself that I could make any important improvement upon the Ruhmkorff coil. That remarkable instrument had been so long in use, and had undergone so much development, that its career of progress might well be considered as nearly, if not quite, played out. But although Ruhmkorff coils had been constructed capable of yielding sparks of unprecedented length, yet it was obvious that the output of electrical energy, when estimated in ampère as well as in volt measurement, must be relatively very inferior to that of smaller coils, in which each convolution of the secondary wire is effected with much less length of wire. In other words, a given weight of material utilised in a number of small coils ought to yield a greater output of energy than the same weight used in the construction of one large coil, the best proportions of length to diameter being in each case adhered to. Moreover, it is well known that, with induction coils of exceptional magnitude, the ordinary



MULTIPLE INDUCTION COIL MACHINE.

* Royal Society. Received May 18th, 1892.

vibrating contact breaker cannot be efficiently employed on account of the rapid destruction of the platinum points; and the method of obviating this difficulty by breaking contact under a cover of alcohol is only compatible with slow action. But by dividing the work amongst several coils, each with a separate vibrating contact breaker, this difficulty is avoided, and the frequency of the spark is multiplied in proportion to the number of coils and contact breakers. With these views, I obtained from Mr. Apps six induction coils, each capable of yielding a maximum spark of 10¼ inches. I had also a six-fold contact breaker constructed of the usual automatic vibrating type, and in which each vibrator was acted upon by an independent electro-magnet of the horse-shoe description. In experimenting with a single contact breaker used with a single coil, I found much advantage in augmenting the power of the working magnet, and in stiffening and shortening the spring greatly beyond the limits of ordinary practice. By so doing I was enabled to reduce the range of vibration, and thus to obtain with a heavy-headed vibrator many times the usual speed of oscillation without reducing the length of spark in nearly the same proportion. With an extremely high speed of interruption, I could obtain sparks 4 inches long in great profusion, though not with rapidity equal to the rate of vibration. To accomplish that degree of rapidity the sparking distance had to be reduced to about one-half; but, considering that a spark of 2 inches is supposed to represent nearly 95,000 volts when delivered between knobs, and would probably give two-thirds of that amount when delivered between points, I saw no sufficient inducement to strive after longer sparks, which can only be obtained by great sacrifice of frequency, involving a general reduction of amperage far exceeding the gain in voltage.

By using two coils in series with an alcohol contact breaker worked slowly, I could get sparks 15 inches long; but I found so many difficulties and inconveniences in a series arrangement, and so little to be gained by it, that I abandoned the pursuit of it, and confined my attention to a combination in parallel. In the first instance I employed a secondary battery of seven large cells to supply the current for exciting my six coils, and I fully expected that their united output would be proportionate to their number, but in this I was disappointed. I found that two coils gave me only about one and a-half the effect of one, and that every additional coil gave a diminished increment of output. In fact, when all the six were in action, I only got about three times the output I obtained from one. It was some time before I discovered the cause of this apparent anomaly; but at last I traced it to the recoil currents from the condensers, which at each interruption of the primary current had to pass through the battery in the reverse direction of the battery current. Thus a conflict of currents was produced in the primary circuit, which checked the acquisition of magnetism by the coils. I saw no remedy for this interference, except the application of a separate battery to each coil, and I accordingly exchanged my single battery of seven large cells for six independent batteries composed of the same number of cells proportionately reduced in size, and when this was done I obtained the full measure of effect.

Side by side with the multiple contact breaker I have a mechanical contact breaker, in which the interruptions are effected by insulated cam wheels fixed on a revolving shaft, which is fitted with spur gear for high velocities. This mode of breaking contact has the advantage of causing the sparks to be delivered in regular sequence, with equal intervals between them. It also enables the exact number of discharges per second to be ascertained; but the automatic interruptor gives a larger output, owing, I suppose, to the fact that each break of contact takes place exactly at the moment when the magnetisation of the coil is matured, whereas with the mechanical break the same degree of coincidence cannot be attained. The six coils are placed vertically beneath an ebonite table, through which the connecting wires are conveyed in strong glass tubes, which also serve as pillars for supporting the sparking points. These points are adjustable for any required length of spark, and they operate in a radial direction against a metallic conductor surrounding an ebonite disc, which, by means of an India-rubber band and multiplying gear, can be very rapidly rotated; and, whether it be at rest or in motion, it serves as a collector, from which the united output of the coils can be drawn off. By rotating the wheel and conveying the current through a series of Geissler tubes fixed upon it in various positions, extremely brilliant symmetrical figures can be produced, but for all other purposes rotation is dispensed with, except to the extent of slight movements to regulate the length of spark without altering the adjustment of the points. A switchboard is provided for the purpose of regulating the number of coils to be thrown into action, so that they can be used singly or in any required number.

The power of this apparatus as indicated by the voltameter is much greater than that of the large hydro-electric machine made for the Polytechnic Institution, but it is very inferior to it in regard to length of spark, to which, however, I attach but little importance. I find it well adapted for experimental investigation, and I have obtained with it some very interesting results. A drawing of it is prefixed to this paper.

My attention was first directed to the heating effect of the secondary current at an air gap on its circuit. The amount of heat developed at this point when all the coils were in operation proved unexpectedly large, and I was surprised to find it almost entirely confined to the negative side of the gap. I found, also, that when the current passed in sparks very little heat was exhibited. It was only when the passage of the current assumed the appearance and condition of an arc that the heat came into prominence. Taking platinum wires of No. 27 B.W. gauge for the positive and negative terminals, which I shall call electrodes, to distinguish them from the sparking points at the collector, I found that the ends could be drawn asunder to a distance of fully an inch before a decided stream of crackling sparks was elicited, and even then the sparks presented a hazy appearance. On re-advancing the ends to each other the sparks diminished, while the haze increased and gradually assumed the condition of a pale blue arc. At a distance of 0·6 inch a well-defined arc could be maintained, though not without a slight admixture of faint sparks, which followed the curvature of the arc. At this distance the heat was sufficient to fuse the end of the platinum wire forming the negative electrode, but the heat did not reach its maximum until the separating distance was reduced to a few hundredths of an inch. At that small distance the negative platinum melted with great rapidity, and ran back in a globule until it got out of melting range of the arc. By following up the melted globule by steadily advancing the positive wire, the negative wire fused at the rate of nearly 3 inches per minute; but however long this process was continued, the positive wire remained to all appearance perfectly cool. Retaining the positive wire unaltered, I increased by successive steps the thickness of the negative wire, to determine the point at which it became too thick to melt and run back in a globule, and it was not until I increased the thickness up to No. 16 gauge, which corresponds to a diameter of 0·065 inch, that I reached this limit. With that wire the end melted into a rounded form, but no longer receded in a gathering globule, as thinner wires did. Iridio-platinum wire of 21 gauge, containing 70 per cent. of iridium, readily melted and receded, though not rapidly, until the globule fell by its weight. In this instance the light emitted from the globule was so intolerably bright as to require darkened spectacles to view it with impunity. I next proceeded to ascertain how far it was necessary to reduce the thickness of the positive wire before it exhibited an equal degree of heat with the thickest wire opposed to it on the negative side, and I found that I had to diminish its diameter to 31 gauge before this equality was reached. Now, the sectional area of No. 16 gauge is 42 times the area of No. 31 gauge, and from these figures an estimate may be formed of the difference in the development of heat on the negative and positive sides. When I employed two carbon electrodes of equal thickness the greater development of heat on the negative side was still very decided, though the difference was not so conspicuous as in the case of the platinum electrodes. In the arc lamp the superiority of heat is largely on the positive carbon, and it is difficult to account for the contrary result obtained in my experiments.

I further varied these experiments by taking the positive discharge from the surface of acidulated water, in which case the negative electrode was melted by the arc flame springing from the water. I also used for the positive electrode a lump of ice sprinkled with salt to make it conduct, and obtained the same result. A reversal of the current made the water boil at the surface and melted a hole in the ice, while the positive platinum remained unheated as usual. In another experiment I enclosed the two platinum electrodes in glass tubes sealed at the outer end, leaving about one-eighth inch of the platinum wire (No. 27) projecting beyond the glass. These sealed ends I immersed in distilled water, and succeeded in melting the exposed portion of the negative wire while submerged in the water.

In another case I used an iron wire (No. 20 gauge) on the negative side, retaining the platinum wire for the positive electrode. In this instance the melted globule ran back very quickly to a distance of about ½ inch, then stopped and burst into intensely brilliant flame, which showed a strong disposition to cross over to the opposite side, but appeared to be beaten back by the blue flame of the arc. Part, however, did reach the positive electrode, and condensed upon it in the state of an oxide. My attention having been thus directed to an appearance of conflict in the arc, I discarded the iron wire and substituted a platinum wire dipped in a brine of common salt, so as to impart a distinguishing yellow colour to any flame that might issue from the negative side in opposition to the flame emanating from the positive side. This caused the arc to be exhibited under two colours —a very decided yellow on the negative side, and the same pale hazy blue as before on the positive side, but the yellow flame was beaten back by the blue flame. Flecks of yellow could, however, be seen to get across occasionally. It was not so easy to produce yellow flame from the positive electrode, because there was not sufficient heat in the positive wire to volatilise the salt; but by using a separate wire encrusted with salt, and holding it alternately immediately in front of each electrode, I could produce yellow flame on either side and observe the difference of its behaviour in the two cases. When held on the positive side a dense unbroken stream of yellow flame supplanted the previous blue, and passed over bodily to the opposite wires; but when held on the negative side the yellow flame struggled with comparative feebleness to cross over, and only reached the positive wire in scanty fragmentary portions. These appearances were strongly suggestive of a dominating force emanating from the positive side and opposed by a weaker force of the same nature in the opposite direction. The oscillations which are known to attend every disruptive discharge necessarily involve passages from the negative as well as the positive side. In fact the spark must be regarded as consisting of a dying out alternating current of prodigious frequency in which the positive alternations have the ascendency over the so-called negative ones; the excess constituting the available current.

Although the arc flame presented no appearance of flowing motion, I thought it necessary to test the question of any movement in the longitudinal direction by bringing the arc in contact with light powdered substances. For this purpose I placed a small heap of chalk dust upon a plate of mica, and caused the arc flame to pass through it, but none of the dust was moved lengthways. The displacement was entirely lateral, the material being neatly heaped up on each side in a ridge, which curved inwards towards the points of the electrodes, beyond which no displacement was visible. The action appeared to be that of a gentle push, rather than that of a sudden impulse; but when sparks passed instead of flame, a scattering force was exerted, which operated sideways, and not in the track of the spark. In this case I observed that the scattered dust showed a tendency to settle upon the plate in curved lines and symmetrical figures. I followed up this hint by sifting fine black dust upon white cardboard and passing sparks over the surface, and I thus

obtained most unmistakable proof of symmetrical arrangement. This, however, was only a crude method of procedure, and it required a great deal of perseverance and innumerable trials before I succeeded in producing the effect in a satisfactory manner. At length, however, I was enabled to produce perfect dust figures which presented pictures of the disruptive discharge revealing the existence of forces of which the eye could otherwise take no cognisance. Many of these figures I got photographed on the spot, and a selection of them accompanies this paper. They represent the effect not of a single discharge but of a succession of sparks, generally beginning with a light one and gradually increasing the power as the dispersion progressed. To put all the power into one discharge had too much dispersive effect and produced greater irregularity in the figure. A perfectly even sifting of the dust was also essential to a good result, and this could only be effected by the entire exclusion of air draughts and a regulated action of the sieve. The best kind of dust to be used and its proper degree of fineness were also matters requiring many experiments to determine. The dust which I ultimately used consisted of calcined magnesia worked up in a mortar with a sufficient quantity of pure carbon to give a dark slate colour to the combined mass. The carbon was in the form of an impalpable powder, and, I believe, consisted of purified lamp black. I tried every variety of discharge I could think of—sometimes weak and sometimes strong—sometimes from a single coil and sometimes from several in combination. The most powerful sparks were obtained by using all the six coils in parallel and discharging them simultaneously by the action of a single alcoholic contact breaker common to the whole. I also used a Leyden battery, consisting of four half-gallon jars, which I joined up in various ways, both in parallel and in series, and in some cases introduced a wet string to soften the discharge.

The circular lines which surround the main discharge, both horizontally and transversely, first demand attention. They appear to represent sections of concentric layers or shells, of which the spark is the nucleus. Their great similitude to the lines of force represented by iron filings under the influence of a magnet is suggestive of similar causation, but I could not find any proof of their identity. The distance to which this circular action extended was far beyond the limit exhibited by the photographs. By laying patches of extremely light dust on paper at various outside distances, I distinctly traced these lines at a distance of 18 inches from the centre of dispersion, and there can be little question of the action existing in a lessened degree at a still greater distance. It can hardly be doubted that the particles of dust are linked together by polar attraction, and they probably represent similar conditions of the air jerked out by the discharge, but whether it be possible to regard them as indications of tracks of diffused discharge of a different character from that of disruption is more than I dare venture to say. I am satisfied that they are not mere ripples resulting from pulsatory vibrations of air, for I find that radial pulsations produced by mechanical means merely clear a circle without the least tendency to form similar rings. I made the experiments by stretching a membrane over a tin cylindrical box, with a small air tube leading from the bottom to near the surface of a dusted card. The membrane was then set in motion by a rapid succession of light taps, which dispersed the dust in the same manner as the spark did, but not the least indication of circular lines could be seen, and yet air puffs play an important part in the process, for the effects are greatly modified by screens, as will presently appear.

(To be continued.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

49. "Improvements in galvanic batteries for producing constant currents." W. WENSKY. Dated January 1st. As a depolarising agent, the inventor employs subchloride of copper. The electrodes of the element are copper and zinc plates. 3 claims.

584. "An improved construction of alternate current dynamo electric motors." M. HUTIN and M. LEBLANC. Dated January 12th. Consists mainly of a fixed ring and a revolving drum within the said ring, each of which is covered with two distinct electric circuits. 1 claim.

1,004. "An improved indicator for electric potentials. SIR W. THOMSON. Dated January 20th. The inventor uses a pair of gold leaves, or, preferably, a single narrow ribbon of gold leaf hung by its middle over a metal bar, and gummed or, preferably, clamped, to keep it in that position. To adjust it to proper sensibility through the desired range of potentials, he places below it a portion of a metal cylinder, not necessarily of circular form. This cylindrical surface is so shaped as to cause, by its inductive action on the leaves, the desired degrees of divergence for several different prescribed potentials. A divided scale is either engraved on the cylindric surface or on the front or back of the containing case, or on both, so as to facilitate the reading of the indications of the instrument, and avoiding parallax due to the position of the eye. 1 claim.

1,035. "Improvements in primary batteries." S. W. MAQUAY. Dated January 20th. The improvements are directed principally to means for readily removing the zinc plates from the liquid when the battery is not in use, and also to the connections and holders for the zincs and carbons. 4 claims.

1,138. "An improved guard for incandescent electric light globes." W. H. MUNNS. (A communication from abroad by J. Mino and W. D. Wastfield, both of America.) Dated January 21st. The guard consists of a wire ring, which, when in position, is located beneath the lamp globe, and is made with interlocking links, by means of which these two ends can be loosely connected together. Another ring, also formed in two halves, is located about half-way up the lamp globe, when in position, and is united to the lower ring by means of vertical wires, which are twisted round it and carried up to the flange of a ring to which they are secured. This ring is made in two halves, and is hinged together in such manner that it can be placed and secured around the lamp holder by means of a set-screw passed through lugs forming a part thereof. 1 claim.

2,522. "Improvements in attachments or fittings for electric light sliding pendants, electroliers, and stand and other extension lamps." W. R. LANE and J. COTTRELL. Dated February 12th. The primary object of the invention is, the dispensing with exposed or outside wires, although insulated in the usual manner. 3 claims.

3,198. "Improvements in galvanic batteries." F. POUDROUX. Dated February 21st. Consists of central cylinder of carbon contained in a porous jar, a hollow cylinder of zinc, contained in a porous jar, surrounding the first, and a hollow cylinder of carbon surrounding the last-mentioned porous jar, and contained in a glass vessel in which the whole apparatus is placed. The central porous jar containing the carbon cylinder is filled with a depolarising liquid consisting of water, containing two-tenths of its weight of nitrate of potash, one-twentieth of its weight of per-oxide of manganese, three-twentieths of its weight of bichromate of soda, and two-twentieths of its weight of sulphuric acid. The second porous jar containing the hollow cylinder of zinc is filled with an exciting liquid consisting of water having dissolved in it three-twentieths of its weight of chlorhydrate of ammonia, and two-twentieths of its weight of nitrate of potash. The outer glass vessel containing the hollow carbon cylinder contains another depolarising liquid, consisting of a solution of bichromate of soda acidulated with one-tenth of its weight of sulphuric acid. 3 claims.

12,828. "Improvements relating to electric motors, chiefly designed for railway and other vehicles." H. H. LAKE. (Communicated from abroad by The Thomson-Houston International Electric Company, of America.) Dated July 28th. Has for its object to increase the power of the motor to such an extent as to enable it to drive the vehicle through reducing gear comprising a single pair of gear wheels, or, in some cases, through a direct connection, while retaining a size and shape of motor adapted to the limited space beneath the vehicle. The main features of the invention whereby this result is accomplished, are the following, that is to say:—The field magnet is in the form of a flat and shallow magnetisable frame enclosing the armature and having interior poles. One or more field coils are placed so as to surround both the poles and the armature, and so as to directly polarise both the armature and the field magnet, and the said field coils are, in turn, surrounded or enclosed by the field magnet frame. This gives a short magnetic circuit of large area in transvere section, while, at the same time, the field coils being almost or entirely surrounded by this circuit, have their maximum magnetising effect. The armature is preferably laminated in the usual manner, and, instead of the wire being wound on its periphery, it is passed through holes in the armature core near the surface thereof, so that the iron of the core extends out between the coils and spreads out to form a continuous iron surface which may be brought very close to the poles, thus diminishing the air space, the magnetic resistance of the field, and consequently the number of apertures required for the magnetisation of the same. 24 claims.

16,080. "Improvements in governors for dynamo-electric machines." M. S. CONLY. Dated September 22nd. Relates to improvements in that class of governors for dynamos which are automatically operated through the influence of the dynamo current to change or alter the voltage, or electromotive force of such current, with each change in the condition of the circuit operated thereby. 11 claims.

16,456. "Improvements in electric switch apparatus or means for controlling electric switches." A. G. BROOKES. (A communication by J. P. Cushing, of America.) Dated September 29th. Has for its object to provide a simple and efficient apparatus to which the independent circuits may be connected, whereby suitable resistances may be interposed in the independent branch circuits simultaneously, or individually, to obtain the desired light effect in the said circuits, and thereby in the particular portion of the theatre or hall in which are located the lamps in the branch circuits. 17 claims.

17,291. "Improvements in electric soldering irons." W. MITCHELL. Dated October 10th. The object of this invention is to provide an improved soldering iron, heated by electricity, the same being compact and easily handled, yet having the wires coiled in successive concentric insulated layers, which are located in a hollow shell at or near the point, the electric connections being internal and protected. 4 claims.

17,406. "Improvements in arc electric lamps." J. T. TODMAN and A. E. ANGOLD. Dated October 13th. Relates more particularly to focus keeping lamps. By the combination of devices the inventors ensure a steady feed, the avoidance of jumping or chattering, and are enabled to strike the right length of arc for producing the best effect in light from the current employed. 2 claims.

17,430. "Improvements in electric or galvanic batteries, and in materials therefor." D. M. LAMB. Dated October 13th. The ingredients used by the inventor are the bi-chromates of potash or of soda, sulphate of copper, and sal-ammoniac, one or more of which ingredients are mixed with black oxide of manganese and a water repellant material or substance, such as rosin, paraffin, ozokerite, or equivalent resinous or waxy material. The inventor reduces all of the above-mentioned materials, save the waxy material, to the condi-

tion of fine powder, and mixes one or more of the ingredients with the black oxide of manganese and the resinous material. This mixture is then heated sufficiently to melt the resinous material, and thoroughly stirred while thus heated, with the result of causing its particles to boil or swell, and roll over each other in such manner that each granule or particle becomes thoroughly coated with water repellant material. The mixture is used to form one electrode of a battery the other being zinc. 14 claims.

ASHES WASHING MACHINE.

THE want of a ready method of dealing with ashes obtained from boiler fires, or other source of heating power, so as to extract the unconsumed fuel, called "breeze," and use it over again, has long been felt by consumers at all large manufactories where steam power is used. Thousands of tons of good fuel are daily thrown away for want of a ready method of cleansing it from the ash with which it leaves the furnaces. Mr. Leoline A. Edwards is introducing a machine which separates the ashes into three portions, viz.: 1. Unburnt fuel, called breeze or cinders, which can be mixed with coal and burnt over again, or for blacksmith's fires, being the finest material procurable. 2. Fine dust, useful for builders in place of sand. 3. Clinker, useful for road making, paths, &c.

In the complete machine, *i.e.*, with the extra sieving arrangement and automatic feed, the action is as follows:—The stoker wheels his barrow of ashes over the pit, upon the top of which there is a grating of bars 2 inches wide. He tips his ashes over this grating, and all that passes through is carried up by means of an elevator into the machine. The large clinkers which remain on the top of the grating are brushed off, leaving the grating clear for the next barrow of ashes. On entering the machine the dust is removed at once by falling into a screen, the meshes of which are ¼-inch or ⅛-inch. This removes the fine dust, the clinkers and breeze then enter the machine to be washed and separated.

The machine consists of a tank or compartment kept full of water, the ashes or breeze to be cleansed, resting on a grating, which is covered by a fine perforated copper plate, allowing a free passage for water, and at the same time preventing the fuel or breeze falling through. The separation is effected by an agitator worked by a crankshaft, giving it a suitable stroke. At each downward plunge of the agitator the water is forced upwards through the perforated copper bottom, causing the material to rise, when, owing to the greater specific gravity of the rubbish, on the return stroke, it precipitates to the bottom; at the same time, the breeze or unburnt fuel, being lighter, works to the surface; and at each stroke of the crank a body of water and quantity of clean breeze is carried on to a plate, which is also perforated, allowing the water to fall into the machine, and thence through a valve to be used over again—the clean breeze being swept by a revolving brush over the ledge. The clinker accumulates on the perforated copper plate, and from time to time is allowed to escape by a valve into the body of the machine, from whence it is raised by an elevator and discharged.

It is claimed that the following figures shows the saving effected by the treatment in this way of the ashes at a central station on a consumption of coal of 600 tons per week:—

10 per cent. of this will remain as ashes = 60 tons, 30 per cent. of useful fuel called breeze which can be mixed with the coal and burnt over again, exists in the ashes = 18 tons, valued at 5s. per ton (generally sold in London at from 12s. to 18s. per ton) ...	£4	10 0
There is also a saving of cartage, only 32 loads of refuse having to be removed instead of 40	0	16 0
Saving per week	£5	6 0

Machine expenses per year—	£	s.	d.		
5 per cent. interest on cost of machine (£150)	7	10	0		
15 per cent. wear and tear	22	10	0		
Labour, 5s. per week	13	0	0		
Coal for driving	51	12	0		
	94	12	0	= 1	16 0
Per week				£3	10 0

Showing 300 per cent. return on outlay.

CORRESPONDENCE.

Notes on the Light of the Electric Arc.

I am indebted to Mr. Trotter for his correction of my version of the mean value of the cosine. It was a careless misquotation from memory.

It was in the last few lines only of my communication, which you had the kindness to print June 10th, that I gave my method for finding mean spherical candle-power. That method was based on the fact that the areas of the zones illuminated at the different angles are in proportion to the cosines of the "latitudes." As a consequence, the weights of the observed candle-powers, if taken at equal angular intervals, are in proportion to the cosines of the corresponding "latitudes." The mean value of the product of candle-power and cosine divided by the mean value of the cosine, $\frac{2}{\pi}$, will give the mean spherical candle-power.

This method is practically the same as the other, in which a semicircle is described on the diameter equal to unity. The semi-circumference is divided into convenient equal parts, the points of division corresponding to north and south "latitudes" from 0° to 90°, at which the measurements of candle-power were taken. (This same result is obtained by considering the arc to be placed at the centre, and continuing each radius vector, if necessary, until it cuts the semicircle). From these points perpendiculars are let fall on the diameter, and then continued beyond further distances equal numerically to the candle-powers at the corresponding "latitudes." A curve is then drawn through the ends of these lines. The area included between it, the diameter, and the two perpendiculars at the ends of the diameter, is numerically equal (the diameter being unity) to the mean spherical candle-power. In this case the smaller weights of the observed candle-powers as 90° is approached are obtained by crowding the ordinates so that an elementary area is, as in the previous method (if we should make it in the form of a plot), proportional to the product of the candle-power and the cosine of the "latitude."

Graphically, I think the latter method by all odds the better, but, practically, the problem might be solved numerically by the former method in much less time, and with much greater accuracy.

A determination of mean spherical candle-power, while of little use in connection with arc lamps, seems to me to be quite useful in connection with glow lamps, owing to the difference in the use of the two kinds for illuminating purposes.

George W. Patterson, Jun.

Ann Arbor,
July 7th, 1892.

Receiving Instruments and Relays for Telegraphic Circuits.

In the ELECTRICAL REVIEW list for July 15th, specification, No. 16,530, of an American patent dated September 29th, of—I presume—last year, relates to improvements in receiving instruments and relays for telegraphic circuits, the said improvements consisting in securing together, at right angles, in a four-pole magnetic field, two suspended coils. My impression is that this double coil four-pole system has been used for more than 15 years past in the Great Northern Telegraph Company's modified recorder, known as the *undulator*.

Will some reader kindly say whether this is so, and whether such a well-known device can, at this "hour of the day," be defended as a valid patent?

E. Raymond-Barker.

The Electric Light in the City.—The City of London Electric Lighting Company Limited, announce that on and after the 1st proximo, the supply of current will be available to customers both day and night.